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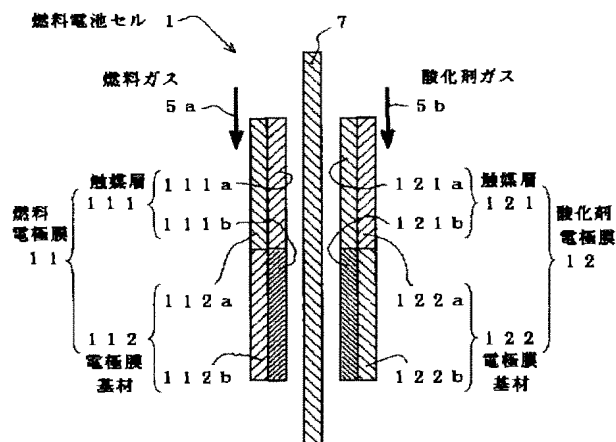
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(54)【発明の名称】 固体高分子電解質型燃料電池用の燃料電池セル

(57)【要約】

【目的】酸化剤電極膜内に過度の生成水の滞留が発生することの無い固体高分子電解質型燃料電池用の燃料電池セルを提供する。

【構成】燃料電池セル1は、従来例に対して、燃料電極膜11と酸化剤電極膜12とを用いている。燃料電極膜11は、0.4〔mm〕厚さのカーボンペーパーを用い、燃料ガス5aの通流方向に2分割された電極膜基材112と、上流側の電極膜基材上には0.02〔mm〕厚さ、下流側の電極膜基材上には0.03〔mm〕厚さとした、白金触媒とフッ素樹脂とからなる多孔質の触媒層111とを有している。酸化剤電極膜12は、0.4〔mm〕厚さのカーボンペーパーを用い、酸化剤ガス5bの通流方向に2分割された電極膜基材122と、上流側の電極膜基材上には0.02〔mm〕厚さ、下流側の電極膜基材上には0.03〔mm〕厚さとした、白金触媒とフッ素樹脂とからなる多孔質の触媒層121とを有している。



【特許請求の範囲】

【請求項1】燃料ガスおよび酸化剤ガスの供給を受けて直流電力を発生する燃料電池セルであって、シート状の固体高分子電解質膜と、この固体高分子電解質膜の両主面のそれぞれに接合されるシート状の燃料電極膜およびシート状の酸化剤電極膜とを備え、それぞれの燃料電極膜および酸化剤電極膜は、燃料ガスまたは酸化剤ガスを触媒層に供給する経路を提供すると共に集電体としての機能を有する多孔質でシート状の電極膜基材と、電極膜基材の一方の側面側のほぼ全面に平面的に担持された触媒層とを有し、それぞれの触媒層側で固体高分子電解質膜の両主面のそれぞれに密着され、反触媒層側である他方の側面側には燃料ガスおよび酸化剤ガスがそれぞれ流通されるものである固体高分子電解質型燃料電池用の燃料電池セルにおいて、

少なくとも酸化剤電極膜が有する触媒層は、触媒層の持つ触媒の担持量が、触媒層の面方向の場所により異なることを特徴とする固体高分子電解質型燃料電池用の燃料電池セル。

【請求項2】請求項1に記載の固体高分子電解質型燃料電池用の燃料電池セルにおいて、

触媒層の持つ触媒の担持量は、流通される酸化剤ガスの出口の近傍に在る触媒層において、酸化剤ガスの入口の近傍に在る触媒層よりも多いことを特徴とする固体高分子電解質型燃料電池用の燃料電池セル。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、固体高分子電解質型燃料電池に使用される燃料電池セルに係わり、酸化剤電極膜内に生成水が過度に滞留するのを防止するように改良されたその構成に関する。

【0002】

【従来の技術】燃料電池は水素と酸素とを利用して直流電力を発生する一種の発電装置であり、すでによく知られているとおり、他のエネルギー機関と比較して、電気エネルギーへの変換効率が高く、しかも、炭酸ガスや窒素酸化物等の大気汚染物質の排出量が少ないことから、いわゆるクリーン・エネルギー源として期待されている。この燃料電池としては、使用される電解質の種類により、固体高分子電解質型、りん酸型、熔融炭酸塩型、固体酸化物型などの各種の燃料電池が知られている。

【0003】近年、内燃機関と比較して、燃料電池は、排気ガスによる大気汚染度が低いこと、運転時の発生音が小さいこと等の大きな特徴を持つことから、燃料電池を自動車等の車両の駆動に用いる駆動用電動機用の車載電源として利用することが考えられるようになってきている。燃料電池を車載電源として利用する際には、電源システムが可能な限り小形であることが望ましく、このような観点から、各種の燃料電池の内でも固体高分子電解質型燃料電池が注目されるようになってきている。

【0004】固体高分子電解質型燃料電池は、分子中にプロトン（水素イオン）交換基を有する高分子樹脂膜を飽和に含水させると、低い抵抗率を示してプロトン導電性電解質として機能することを利用した燃料電池である。この分子中にプロトン交換基を有する高分子樹脂膜（以降、固体高分子電解質膜または単にPE膜と略称することがある。）としては、パーフルオロスルホン酸樹脂膜（例えば、米国のデュポン社製、商品名ナフィオン膜）を代表とするフッ素系イオン交換樹脂膜が現時点では著名であるが、この他に、炭化水素系イオン交換樹脂膜、複合膜等が用いられている。これ等の固体高分子電解質膜（PE膜）は、飽和に含水されることにより、常温で20〔Ω・cm〕以下の抵抗率を示し、いずれも、プロトン導電性電解質として機能する膜である。

【0005】この固体高分子電解質型燃料電池のシステムは、一般に、図4にその概念図を示す電池本体8を中核として構成されている。電池本体8は、シート状のPE膜7と、このPE膜7の両主面のそれぞれに接合されたシート状の燃料電極（アノード）膜61、およびシート状の酸化剤電極（カソード）膜62とからなる燃料電池セルを、通常は複数積層して構成されている。それぞれの燃料電極膜61および酸化剤電極膜62は、触媒層61a、62aと、触媒層61a、62aを担持し、燃料ガス（水素、あるいは水素を高い濃度で含むガス。）または酸化剤ガス（酸素、あるいは空気のように酸素を高い濃度で含むガス。）を触媒層61a、62aに供給および排出すると共に、集電体としての機能を有する多孔質の電極膜基材（使用材料としては、例えば、カーボンペーパーが用いられる。）61b、62bとから構成されており、触媒層61a、62aがPE膜7の両主面のそれぞれに密着されている。

【0006】上記の構成を持つ燃料電池セルを用いた電池本体8においては、燃料電極膜61には燃料ガスを、また、酸化剤電極膜62には酸化剤ガスを供給するのであるが、これ等の反応ガス（燃料ガスと酸化剤ガスとを総称する場合には、このように言うことが有る。）は、加湿して水蒸気を含んだ状態にして供給される。その理由は、PE膜7は、前記したように、飽和に含水されることでプロトン導電性電解質として機能する膜であるが、逆のことを言えば、PE膜7は乾燥されてその水分量が低減されると、プロトン導電性が低下してその抵抗率が増大してしまう膜であるからである。燃料電極膜61、酸化剤電極膜62に反応ガスが供給されると、それぞれの電極膜61、62に備えられた触媒層61a、62aと、PE膜7との界面に、気相（燃料ガスまたは酸化剤ガス）・液相（液状のH₂O）・固相（燃料電極、酸化剤電極が持つ触媒）の三相界面が形成され、電気化学反応を生じさせることで直流電力を発生させている。なお、触媒層61a、62aは、多くの場合に、微小な粒子状の白金触媒とは水性を有するフッ素樹脂とから

形成されており、しかも層内に多数の細孔が形成されるようにすることで、反応ガスの三相界面までの効率的な拡散を維持すると共に、十分広い面積の三相界面が形成されるように構成されている。

【0007】この三相界面では、次記する電気化学反応が生じる。まず、燃料電極膜61側では(1)式による反応が起こる。

【0008】

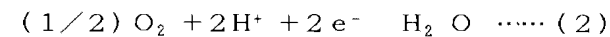
【化1】



また、酸化剤電極膜62側では(2)式による反応が起こる。

【0009】

【化2】



すなわち、この反応の結果、燃料電極膜61で生成された H^+ イオン(プロトン)は、PE膜7中を酸化剤電極膜62に向かって移動し、また、電子(e^-)は負荷装置9を通して酸化剤電極膜62に移動する。一方、酸化剤電極膜62では、酸化剤ガス中に含有される酸素と、PE膜7中を燃料電極膜61から移動してきた H^+ イオンと、負荷装置9を通して移動してきた電子とが反応し、 H_2O (水蒸気)が生成される。かくして、電池本体8は、水素と酸素とを得て直流電力を発生し、そうして、副生物として H_2O (水蒸気)を生成している。

【0010】ところで、燃料電池セルは、それぞれ別個に準備されたPE膜7と、燃料電極膜61と、酸化剤電極膜62とを、触媒層61a、62aをPE膜7の互いに異なる主面に対向させるようにして重ね合わせ、加熱・加圧を行って接合するようしている。このようにして得られた燃料電池セルは図5と、図6内に示す構造・形状を備えている。ここで図5は、図4に示した電池本体に用いられる従来例の燃料電池セルを展開した状態で模式的に示した要部の側面断面図である。すなわち、燃料電池セル6は、薄い厚さを持つ矩形状をなしており、これに用いられているPE膜7は、燃料電極膜61と酸化剤電極膜62の面方向の外形寸法よりも大きい面方向の外形寸法を持つものであり、従って、燃料電極膜61ならびに酸化剤電極膜62の周辺部には、PE膜7の端部との間に図5、図6中に示すようにPE膜7の露出面が存在している。この燃料電池セル6の厚さ寸法は、多くの場合に1〔mm〕程度あるいはそれ以下であり、また、その場合の燃料電池セル6を構成しているPE膜7の厚さ寸法は、0.1〔mm〕～0.2〔mm〕程度である。

【0011】この燃料電池セル6は、図6に示した構成を持つ単位燃料電池装置5に組み込まれ、この単位燃料電池装置5の必要とする個数を積層して、電池本体8が形成されるのである。ここで図6は、図5に示した燃料電池セルを用いて構成された一般例の単位燃料電池装置

を模式的に示した要部の側面断面図である。なお、図6中には、図5で付した符号については、代表的な符号のみを記した。図6において、単位燃料電池装置5は、燃料電池セル6と、この燃料電池セル6の一方の側面に配設されて燃料ガス5aを通流させる溝51aを複数持つセパレータ51と、燃料電池セル6の他方の側面に配設されて酸化剤ガス5bを通流させる溝52aを複数持つセパレータ52と、例えば、Oリング等のシール体53とが備えられている。それぞれのセパレータ51、52は、PE膜7の露出している周辺部で、シール体53を介して燃料電池セル6を挟むようにして配設されている。なお、シール体53は、セパレータ51、52の溝51a、52a中に通流する反応ガスが、通流路外に漏れ出るのを防止する役目を負うものであり、それぞれのセパレータ51、52の周縁部に形成された溝51b、52b中に嵌め込まれて装着されている。

【0012】燃料電池セル6に供給される反応ガスは、その供給側を重力方向に対して上側に、その排出側を重力方向に対して下側になるように配置されるのが一般である。これは、燃料電池セル6においては、前記したように、発電時の副生物として水蒸気が生成されるが、この水蒸気のために、下流側の反応ガスほど多量に水蒸気含有されることとなり、この結果、排出端付近の反応ガスでは過飽和に相当する水蒸気が凝結して液体状態の水として存在することとなる可能性が有るためである。反応ガスの供給側を重力方向に対して上側に、反応ガスの排出側を重力方向に対して下側になるように配置することで、凝結した水は、反応ガス通流用の溝51a、52a中を重力により自力で流下できるので、それぞれの単位燃料電池装置5からの凝結した水の除去が容易になるのである。

【0013】ところで、燃料電池セル6で行われる前記の(1)式、(2)式で記述した電気化学反応は、発熱反応である。従って、燃料電池セル6で(1)式、

(2)式による電気化学反応によって発電を行う際には、発生される直流電力値とほぼ同等値の熱が発生することも避けられないものである。このために、単位燃料電池装置5を用いて電池本体8を構成する場合には、燃料電池セル6から熱を除去するための、図示しない冷却手段が組み込まれる。これにより、燃料電池セル6は、70〔℃〕から80〔℃〕程度の温度条件で運転されるのが一般である。

【0014】そうして、従来技術の燃料電池セル6の一例を具体的に示すと、PE膜7としては、厚さ寸法が0.17〔mm〕のナフィオン膜が用いられている。電極膜基材61b、62bとしては、厚さ寸法が0.4〔mm〕のカーボンペーパーが用いられている。また、白金黒を20〔%〕担持したカーボン粉末とポリテトラエチレンのディスパーション混合液を、前記の電極膜基材61b、62bに0.025〔mm〕の均一の厚さに

付着させ、真空乾燥器によって24[h]乾燥を行った後、365[℃]で15[min]の間焼成している。これにより、電極膜基材61b、62b上に触媒層61a、62aが形成された、燃料電極膜61および酸化剤電極膜62を得ている。この燃料電極膜61と酸化剤電極膜62とを、触媒層61aと触媒層62aとの側でPE膜7を間に挟んだ挟持体を、120[℃]、3.5[MPa]の条件で、15[min]の間加熱・加圧して両膜を接合し、燃料電池セル6を得ている。

【0015】

【発明が解決しようとする課題】前述した従来技術による固体高分子電解質型燃料電池用の燃料電池セルを用いて、所望の発電性能を備える固体高分子電解質型燃料電池を得ることができているが、次記するような問題点が残存している。すなわち、前述したように、燃料電池セルで生じている電気化学反応は、酸化剤電極膜で水蒸気が副生される反応であり、この水蒸気は主に酸化剤電極膜から酸化剤ガス中に排出される。このために、酸化剤ガス中の水蒸気量は、燃料電池セルの入口部で最も少なく、燃料電池セルを通過するに従って順次増加して行く。その際、生成水を酸化剤電極膜から酸化剤ガス中に排出し易くするためには、酸化剤電極膜内の水蒸気圧力値を酸化剤ガス中の水蒸気圧力値よりも高くすることが望ましいものである。

【0016】酸化剤電極膜の温度が均一であるとする、上記した理由により、燃料電池セルからの出口部近傍では、酸化剤ガス中の水蒸気量が多くなるために、酸化剤ガスの水蒸気圧力値は高くなる。このために、出口部近傍の酸化剤電極膜からの生成水の排出が困難となる。さらに、酸化剤ガス中の水蒸気圧力値が飽和水蒸気圧に到達していった場合（前記の理由により、出口部近傍において発生する確率が高い。）には、酸化剤電極膜からの生成水の排出が停止状態となるために、反応によって生成された水蒸気が凝縮して液状となった生成水が、酸化剤電極膜内に多量に滞留されることになる。酸化剤電極膜内に生成水が多量に滞留されると、触媒層内の細孔が生成水によって充満されてしまうと、電極膜基材に形成されている空隙の少なくとも一部が生成水によって充満されてしまう事態となる。こうなると、酸化剤電極膜内での酸化剤ガスの拡散が阻害されることになり、前述した燃料電池セルにおける反応が低下し、燃料電池セルの発電性能の低下を招くことに到る。

【0017】酸化剤電極膜内に生成水が多量に滞留されるのを防止する策として、燃料電池セルに供給する酸化剤ガスに含ませる水蒸気量を減らすことが考えられるが、この場合には、含ませる水蒸気量を減らし過ぎることによってPE膜が乾燥してしまうと、PE膜の抵抗率が増大することによって燃料電池の出力特性の低下を招く恐れが生じるので、酸化剤ガスの加湿度の調整・管理が大変困難になるという新たな問題が発生する。

【0018】この発明は、前述の従来技術の問題点に鑑みなされたものであり、その目的は、酸化剤電極膜内に過度の生成水の滞留が発生することの無い、固体高分子電解質型燃料電池用の燃料電池セルを提供することにある。

【0019】

【課題を解決するための手段】この発明では前述の目的は、

1) 燃料ガスおよび酸化剤ガスの供給を受けて直流電力を発生する燃料電池セルであって、シート状の固体高分子電解質膜と、この固体高分子電解質膜の両主面のそれぞれに接合されるシート状の燃料電極膜およびシート状の酸化剤電極膜とを備え、それぞれの燃料電極膜および酸化剤電極膜は、燃料ガスまたは酸化剤ガスを触媒層に供給する経路を提供すると共に集電体としての機能を有する多孔質でシート状の電極膜基材と、電極膜基材の一方の側面側のほぼ全面に平面的に担持された触媒層とを有し、それぞれの触媒層側で固体高分子電解質膜の両主面のそれぞれに密着され、反触媒層側である他方の側面側には燃料ガスおよび酸化剤ガスがそれぞれ通流されるものである固体高分子電解質型燃料電池用の燃料電池セルにおいて、少なくとも酸化剤電極膜が有する触媒層は、触媒層の持つ触媒の担持量が、触媒層の平方向の場所により異なる構成とすること、または、

2) 前記1項に記載の手段において、触媒層の持つ触媒の担持量は、通流される酸化剤ガスの出口の近傍に在る触媒層において、酸化剤ガスの入口の近傍に在る触媒層よりも多い構成とすること、により達成される。

【0020】

【作用】前記の(1)式、(2)式に示した電気化学反応は、前述したように触媒が係わって行われる反応であるから、この電気化学反応の際に発生される熱量は、燃料電池セルの触媒の担持量に対応して発生されるものである。この発明は、この点に着目して行われたものである。

【0021】すなわち、この発明においては、固体高分子電解質型燃料電池用の燃料電池セルにおいて、少なくとも酸化剤電極膜が有する触媒層は、触媒層の持つ触媒の担持量が、例えば、通流される酸化剤ガスの出口の近傍に在る触媒層が持つ触媒の担持量を、酸化剤ガスの入口の近傍に在る触媒層が持つ触媒の担持量よりも多くする等、触媒層の面方向の場所により異なる構成とすることにより、少なくとも酸化剤電極膜では、触媒の担持量の関係で、反応ガスの入口の近傍に対して、反応ガスの出口の近傍における発熱量が増大されることになる。

【0022】これにより、酸化剤ガスの出口部付近における酸化剤電極膜の運転時温度を、酸化剤ガスの入口部付近の酸化剤電極膜の運転時温度と比較して、出口部近傍の酸化剤電極膜からの生成水の排出が容易となるレベルに高くなし得ることで、酸化剤ガスの出口側近傍の酸

化剤電極膜から酸化剤ガスへの生成水の排出能が向上されることになる。

【0023】また、反応ガス、例えば、酸化剤ガス中の酸素は、燃料電池セルにおける電気化学反応によって消費されるために、酸化剤ガス中の酸素濃度は、入口部近傍の酸化剤ガスに対して出口部近傍の酸化剤ガスでは低下するものである。前記の構成を備えるこの発明の燃料電池セルが持つ少なくとも酸化剤電極膜では、反応ガスの出口の近傍における電気化学反応の反応能が増大されるために、例えば酸素濃度が低下した出口部近傍の反応ガスであっても、入口部近傍における電気化学反応度とほぼ同様の電気化学反応度を維持できて、燃料電池セル面の反応ガス通流方向における電気化学反応度をほぼ均一にできることになる。

【0024】

【実施例】以下この発明の実施例を図面を参照して詳細に説明する。図2は、この発明の一実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図である。（後記する異なる実施例等と区別する場合には、実施例ということがある。）図2において、図5に示した従来例による固体高分子電解質型燃料電池用の燃料電池セルと同一部分には同じ符号を付し、その説明を省略する。

【0025】図2において、2は、図5に示した従来例による燃料電池セル6に対して、酸化剤電極膜62に替えて、酸化剤電極（カソード）膜12を用いるようにした燃料電池セルである。酸化剤電極膜12は、図5中に示した従来例の燃料電池セル6が持つ酸化剤電極膜62に対して、触媒層62aに替えて触媒層121を、電極膜基材62bに替えて電極膜基材122を用いるようにしている。

【0026】電極膜基材122は、電極膜基材62bと同様に、多孔質の電極膜基材として厚さ寸法が0.4〔mm〕のカーボンペーパーが用いられているが、図2中に示したように、酸化剤ガス5bが通流される方向に沿って、電極膜基材122a、122bにそれぞれ2分割されている。そうして、反応ガスの上流側の電極膜基材122aには、従来例の場合と同一内容のディスパーション混合液を、0.02〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層121aを形成している。

【0027】また、反応ガスの下流側の電極膜基材122bには、従来例の場合と同一内容のディスパーション混合液を、0.03〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層121bを形成している。そうして、触媒層121aと触媒層121bとで触媒層121を形成している。

【0028】これ等の、燃料電極膜61および酸化剤電

極膜12とを、触媒層61aと触媒層121との側でPE膜7を間に挟んだ挟持体を、120〔℃〕、3.5〔MPa〕の条件で、15〔min〕の間加熱・加圧して両膜を接合し、燃料電池セル2を得ている。図2に示す実施例では前述の構成としたので、酸化剤電極膜12では、触媒の担持量の関係で、酸化剤ガス5bの入口の近傍に対して、酸化剤ガス5bの出口の近傍における発熱量が増大されることになる。このため、酸化剤ガス5bの出口部近傍における酸化剤電極膜12の運転時温度を、酸化剤ガス5bの入口部近傍の酸化剤電極膜12の運転時温度と比較して、出口部近傍の酸化剤電極膜12からの生成水の排出が容易となるレベルに積極的に高くなし得る。これにより、酸化剤ガス5bの出口部近傍の酸化剤電極膜12から酸化剤ガス5bへの生成水の排出能が向上されることになる。また、酸化剤ガス5bの出口の近傍における電気化学反応の反応能が増大されるために、酸素濃度が低下した出口部近傍の酸化剤ガス5bであっても、入口部近傍における電気化学反応度とほぼ同様の電気化学反応度を維持できる。このため、燃料電池セル2の表面の酸化剤ガス5b通流方向における電気化学反応度の均一度を改善できることになる。

【0029】図1は、この発明の異なる実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図である。（他の実施例と区別する場合には、実施例ということがあ

る。）図1において、図2に示したこの発明の一実施例による固体高分子電解質型燃料電池用の燃料電池セル、図5に示した従来例による固体高分子電解質型燃料電池用の燃料電池セルと同一部分には同じ符号を付し、その説明を省略する。

【0030】図1において、1は、図2に示したこの発明の一実施例による燃料電池セル2に対して、燃料電極膜61に替えて、燃料電極（アノード）膜11を用いるようにした燃料電池セルである。燃料電極膜11は、図2、図5中に示した燃料電極膜61に対して、触媒層61aに替えて触媒層111を、電極膜基材61bに替えて電極膜基材112を用いるようにしている。

【0031】電極膜基材112は、電極膜基材61bと同様に、多孔質の電極膜基材として厚さ寸法が0.4〔mm〕のカーボンペーパーが用いられているが、図1中に示したように、燃料ガス5aが通流される方向に沿って、電極膜基材112a、112bに2分割されている。そうして、反応ガスの上流側の電極膜基材112aには、従来例の場合と同一内容のディスパーション混合液を、0.02〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層111aを形成している。

【0032】また、反応ガスの下流側の電極膜基材112bには、従来例の場合と同一内容のディスパーシ

ン混合液を、0.03〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層111bを形成している。そして、触媒層111aと触媒層111bとで触媒層111を形成している。

【0033】これ等の、燃料電極膜11および酸化剤電極膜12とを、触媒層111と触媒層121との側でPE膜7を間に挟んだ挟持体を、120〔℃〕、3.5〔MPa〕の条件で、15〔min〕の間加熱・加圧して両膜を接合し、燃料電池セル1を得ている。図1に示す実施例では前述の構成としたので、図2に示した実施例における構成に加えて、燃料電極膜11でも、触媒の担持量の関係で、燃料ガス5aの入口の近傍に対して、燃料ガス5aの出口の近傍における発熱量が増大されることになる。燃料電極膜11と酸化剤電極膜12とが共に、反応ガスの出口部近傍における発熱量が、反応ガスの入口部近傍における発熱量よりも増大されることにより、酸化剤ガス5bの出口部近傍における酸化剤電極膜12の運転時温度の、酸化剤ガス5bの入口部近傍の酸化剤電極膜の運転時温度に対する温度差を、図2に示した実施例の場合よりも高くすることが可能となる。これにより、出口部近傍の酸化剤電極膜12から酸化剤ガス5bへの生成水の排出能が一層向上されることになる。また、酸化剤ガス5bに対する場合に加えて、燃料ガス5aの出口の近傍における電気化学反応の反応能も増大されるために、水素濃度が低下した出口側付近の燃料ガス5aであっても、入口側付近における電気化学反応度とほぼ同様の電気化学反応度を維持できる。このため、燃料電池セル2の両表面の反応ガス通流方向における電気化学反応度をほぼ均一にできることになる。

【0034】図3は、この発明のさらに異なる実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図である。(他の実施例と区別する場合には、実施例ということがある。)図3において、図5に示した従来例による燃料電池セルと同一部分には同じ符号を付し、その説明を省略する。

【0035】図3において、3は、図5に示した従来例による燃料電池セル6に対して、燃料電極膜61および酸化剤電極膜62に替えて、それぞれ、燃料電極(アノード)膜31および酸化剤電極(カソード)膜32を用いるようにした燃料電池セルである。燃料電極膜31は、図5中に示した従来例の燃料電池セル6が持つ燃料電極膜61に対して、触媒層61aに替えて触媒層311を、電極膜基材61bに替えて電極膜基材312を用いるようにしている。また、酸化剤電極膜32は、図5中に示した従来例の燃料電池セル6が持つ酸化剤電極膜62に対して、触媒層62aに替えて触媒層321を、電極膜基材62bに替えて電極膜基材322を用いるようにしている。

【0036】それぞれの電極膜基材312、322は、電極膜基材61b、62bと同様に、多孔質の電極膜基材として厚さ寸法が0.4〔mm〕のカーボンペーパーが用いられているが、図3中に示したように、燃料ガス5aおよび酸化剤ガス5bが通流される方向に沿って、電極膜基材312a、312b、312c、および、電極膜基材322a、322b、322c、にそれぞれ3分割されている。そして、反応ガスの上流側のそれぞれの電極膜基材312a、322aには、従来例の場合と同一内容のディスパージョン混合液を、0.02〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層311a、321aを形成している。

【0037】また、反応ガスの中流域のそれぞれの電極膜基材312b、322bには、従来例の場合と同一内容のディスパージョン混合液を、0.025〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層311b、321bを形成している。さらに、反応ガスの下流域のそれぞれの電極膜基材312c、322cには、従来例の場合と同一内容のディスパージョン混合液を、0.03〔mm〕の均一の厚さに付着させ、真空乾燥器によって24〔h〕乾燥を行った後、365〔℃〕で15〔min〕の間焼成して、触媒層311c、321cを形成している。そして、触媒層311a、触媒層311b、触媒層311cとで触媒層311を形成し、触媒層321a、触媒層321b、触媒層321cとで触媒層321を形成している。

【0038】これ等の燃料電極膜31および酸化剤電極膜32とを、触媒層311と触媒層321との側でPE膜7を間に挟んだ挟持体を、120〔℃〕、3.5〔MPa〕の条件で、15〔min〕の間加熱・加圧して両膜を接合し、燃料電池セル3を得ている。図3に示す実施例では前述の構成としたので、図1に示した実施例における構成の場合と比較して、両電極膜(燃料電極膜31等と酸化剤電極膜32等を総称する場合には、このように言うことがある。)の触媒の担持量の関係で、反応ガスの入口部近傍から反応ガスの出口部近傍に到る間の発熱量の増大度が均等化されることになる。このため、酸化剤電極膜32の運転時温度の、酸化剤ガス5bの入口部近傍から酸化剤ガス5bの出口部近傍に到る間の変化を、しだいに高くするようにすることが可能となる。これにより、酸化剤電極膜12から酸化剤ガス5bへの生成水の排出能を、出口部近傍を含み、酸化剤電極膜32のほぼ全面にわたって向上させることが可能になる。また、燃料電池セル2の両表面の反応ガス通流方向における電気化学反応度を一層均一化することが可能となる。

【0039】この実施例の項で今まで説明してきた実施

例による燃料電池セル、および従来例の燃料電池セルを用いた単位燃料電池装置のそれぞれについて、燃料電極膜および酸化剤電極膜が持つ温度分布の実測例をまとめて「表1」中に示す。なお、「表1」において、安定性の評価は、それぞれの単位燃料電池装置を24時

間連続して運転し、それぞれの単位燃料電池装置が出力する電圧値の低下度が2〔%〕未満であったものは○とし、2〔%〕以上であったものは△としている。

【0040】

【表1】

【0041】「表1」において、反応ガスの入口部の温度（「表1」中のa、b）と反応ガスの出口部の温度（「表1」中のa、b）との温度差に着目すると、従来例での温度差が僅か約3〔℃〕であるのに対して、この発明による実施例～の場合では、6～7〔℃〕程度の温度差が得られている。またこれにより、反応ガスの出口部近傍を含む酸化剤電極膜12、32中には、生成水が多量に滞留されることが解消されることで、生成水が多量に滞留されることが主原因となって発生する出力電圧値の低下度が減少されていることが確認できる。

【0042】実施例における今までの説明では、燃料電池セル1～3が備える電極膜基材112、122、312、322は、反応ガスの通流する方向に複数に分割されるとしてきたが、これに限定されるものではなく、例えば、燃料電池セル1～3が備える燃料電極膜、酸化剤電極膜用の電極膜基材は一体のものであってもよく、電極膜基材上に形成される触媒層は、この一体の電極膜基材に反応ガスの通流する方向に厚さを変えて形成されてもよいものである。

【0043】

【発明の効果】この発明においては、固体高分子電解質型燃料電池用の燃料電池セルを前述の構成とすることにより、反応ガスの入口部と出口部との間の温度差に着目すると、表1中に示したように、従来例の場合に対して2倍以上の温度差を得ることが可能となる。これにより、少なくとも酸化剤電極膜中に生成水が多量に滞留されて、酸化剤電極膜内で酸化剤ガスの拡散が阻害される

ことが解消されるので、燃料電池セルの出力電圧値の低下度が減少されたとの効果を奏する。

【図面の簡単な説明】

【図1】この発明の異なる実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図

【図2】この発明の一実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図

【図3】この発明のさらに異なる実施例による固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図

【図4】一般例の固体高分子電解質型燃料電池を示すその概念図

【図5】従来例の固体高分子電解質型燃料電池用の燃料電池セルを展開した状態で模式的に示した要部の側面断面図

【図6】図5に示した燃料電池セルを用いて構成された一般例の単位燃料電池装置を模式的に示した要部の側面断面図

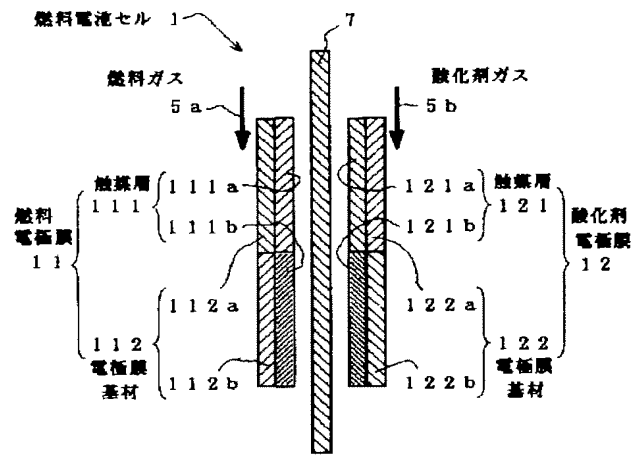
【符号の説明】

- 1 燃料電池セル
- 11 燃料電極膜
- 111 触媒層
- 112 電極膜基材
- 12 酸化剤電極膜
- 121 触媒層
- 122 電極膜基材

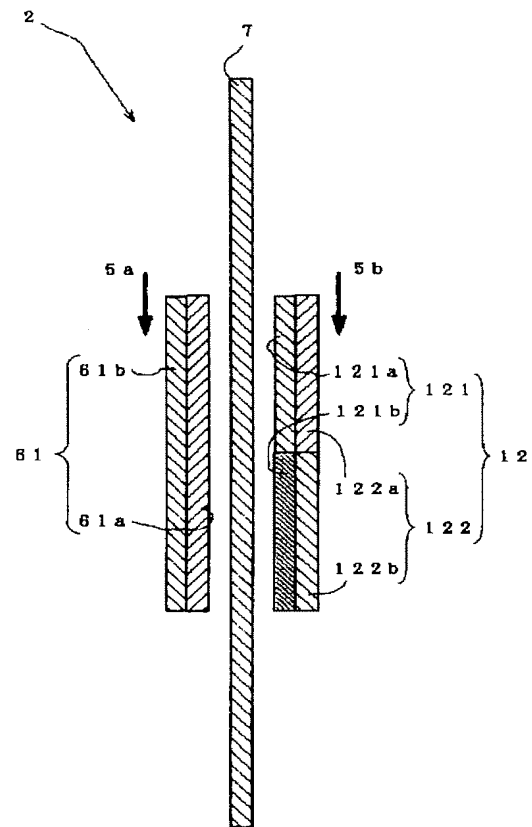
5 a 燃料ガス

5 b 酸化剤ガス

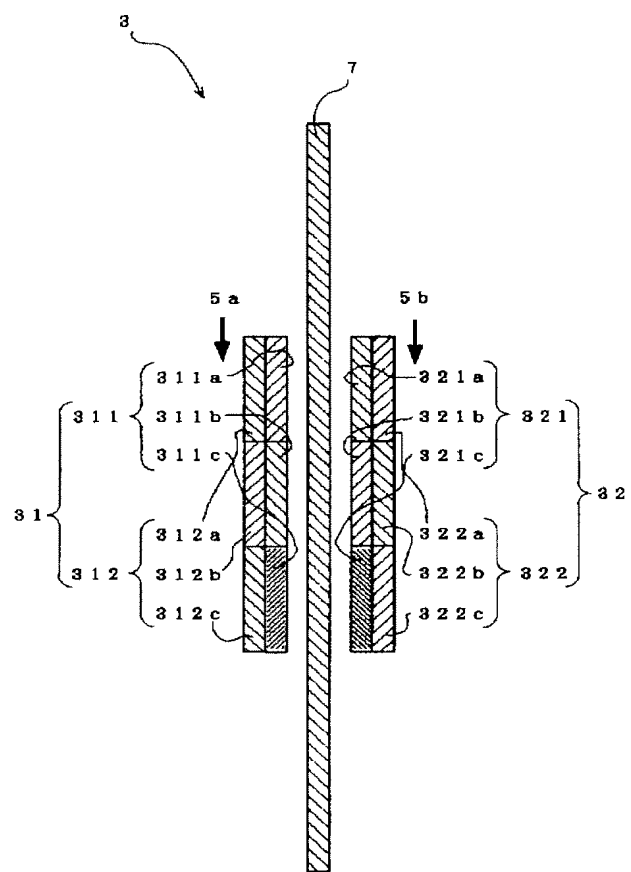
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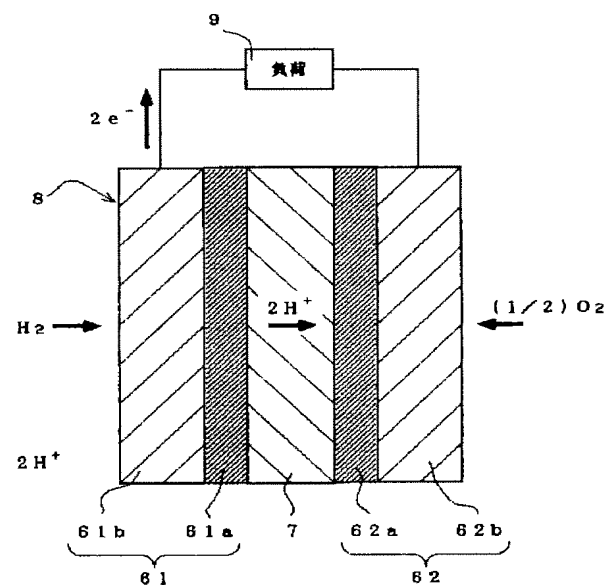
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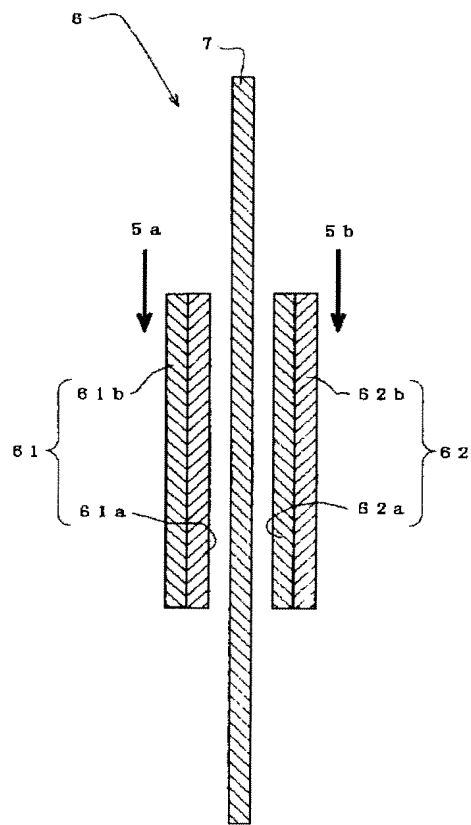
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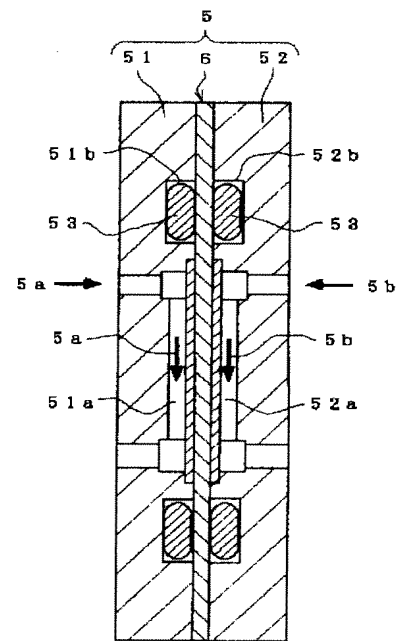
【図4】



【図5】



【図6】



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DETAIL

JAPANESE

LEGAL
STATUS

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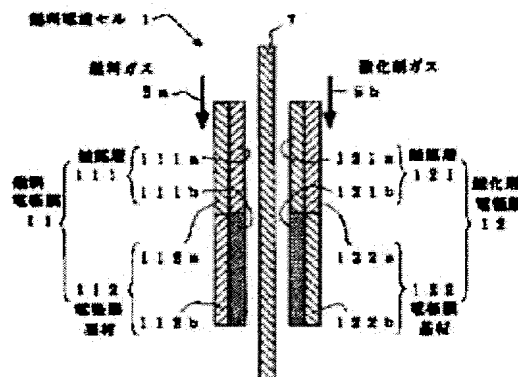
(72)Inventor : YANAGIUCHI KAZUKI

(54) CELL FOR SOLID HIGH POLYMER ELECTROLYTE FUEL CELL

(57)Abstract:

PURPOSE: To provide a cell for a solid high polymer electrolyte fuel cell by which excessive generating water does not stay in an oxidating agent electrode film.

CONSTITUTION: A cell 1 of a fuel cell uses a fuel electrode film 11 and an oxidating agent electrode film 12. The fuel electrode film 11 uses carbon paper having a thickness of 0.4mm and has an electrode film base material 112 divided into two parts in the flowing direction of fuel gas 5a and a porous catalyst layer 111 which has a thickness of 0.02mm on an upstream side electrode film base material and a thickness of 0.03mm on a downstream side electrode film base material and is composed of a platinum catalyst and a fluororesin. The oxidating agent electrode film 12 uses carbon paper having a thickness of 0.4mm and has an electrode film base material 122 divided into two parts in the flowing direction of oxidating agent gas 5b and a porous catalyst layer 121 which has a thickness of 0.02mm on an upstream side electrode film base material and a thickness of 0.03mm on a downstream side electrode film base material and is composed of a platinum catalyst and a fluororesin.



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CLAIMS

[Claim(s)]

[Claim 1]Have the following and it is stuck by each of both principal planes of solid polyelectrolyte membrane by each catalyst bed side, In a fuel cell cell for solid polyelectrolyte type fuel cells which is that by which conduction of fuel gas and the oxidant gas is carried out to the side side of another side which is an anti-catalyst bed side, respectively, A fuel cell cell for solid polyelectrolyte type fuel cells to which a catalyst bed which an oxidant electrode film has at least is characterized by a holding amount of a catalyst which a catalyst bed has changing with places of a plane direction of a catalyst bed.

In response to supply of fuel gas and oxidant gas, are direct current power a fuel cell cell to generate, and Sheet shaped solid polyelectrolyte membrane, Have sheet shaped fuel electrode film and sheet shaped oxidant electrode film which are joined to each of both principal planes of this solid polyelectrolyte membrane, and each fuel electrode film and an oxidant electrode film, It is the porosity which a course which supplies fuel gas or oxidant gas to a catalyst bed is provided, and has a function as a charge collector, and is a sheet shaped electrode layer substrate.

A catalyst bed superficially supported all over almost by the side of one side of an electrode layer substrate.

[Claim 2]In a fuel cell cell for the solid polyelectrolyte type fuel cells according to claim 1, a holding amount of a catalyst which a catalyst bed has, A fuel cell cell for solid polyelectrolyte type fuel cells characterized by being more than a catalyst bed near the entrance of oxidant gas in a catalyst bed near the exit of oxidant gas by which conduction is carried out.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to that composition improved so that produced water might be prevented from stagnating too much in an oxidant electrode film with respect to the fuel cell used for a solid polyelectrolyte type fuel cell.

[0002]

[Description of the Prior Art] A fuel cell is a kind of power plant which generates direct current power using hydrogen and oxygen, and it is compared with other Energy Agencies as it is already known well. The conversion efficiency to electrical energy is high, and moreover, since there are few discharges of air pollution substances, such as carbon dioxide and nitrogen oxides, it is expected as what is called a source of clean energy. As this fuel cell, various kinds of fuel cells, such as a solid polymer electrolyte type, a phosphoric acid type, a melting carbonate type, and a solid oxide type, are known by the kind of electrolyte used.

[0003] In recent years, since it has the big features, like that the air pollution degree of a fuel cell by exhaust gas is low, and the generating sound at the time of operation is small as compared with an internal-combustion engine, it can be possible to use as a mounted power supply for the electric motors for a drive which uses a fuel cell for the drive of vehicles, such as a car. When using a fuel cell as a mounted power supply, it is desirable for a power supply system to be small as much as possible, and a solid polyelectrolyte type fuel cell attracts attention increasingly also among various kinds of fuel cells from such a viewpoint.

[0004] When a solid polyelectrolyte type fuel cell carries out the water of the Polymer Division resin layer which has a proton (hydrogen ion) exchange group in a molecule to saturation, it is a fuel cell using low resistivity being shown and functioning as a proton conductivity electrolyte. As a Polymer Division resin layer (it is sometimes only henceforth called [solid polyelectrolyte membrane or] PE film for short.) which has a proton exchange group in this molecule, Although the fluorine system ion exchange resin membrane which makes representation a perfluoro sulfonic-acid-type-resin film (for example, the U.S. Du Pont make, a trade name Nafion film) is prominent at present, hydrocarbon system ion exchange resin membrane, bipolar membrane, etc. are used. By carrying out water to saturation, solid polyelectrolyte membrane (PE film), such as this, is ordinary temperature, and is 20. [Omega-cm] The following resistivity is shown and all are the films which function as a proton conductivity electrolyte.

[0005] Generally the system of this solid polyelectrolyte type fuel cell is constituted considering the cell proper 8 which shows drawing 4 that key map as a core. The cell proper 8 usually carries out the plural laminates of the fuel cell cell which consists of the sheet shaped PE film 7, and the sheet shaped fuel electrode (anode) film 61 joined to each of the both principal planes of this PE film 7 and the sheet shaped oxidant electrode (cathode) film 62, and is constituted. Each fuel electrode film 61 and the oxidant electrode film 62, Support the catalyst beds 61a and 62a and the catalyst beds 61a and 62a, and supply and discharge fuel gas (gas which contains hydrogen or hydrogen by high concentration.), or oxidant gas (gas which contains oxygen by high concentration like oxygen or air.) to the catalyst beds 61a and 62a, and. It comprises the electrode layer substrates (as the material of construction, carbon paper is used, for example.)

61b and 62b of the porosity which has a function as a charge collector.

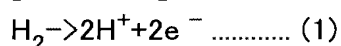
It is stuck to the catalyst beds 61a and 62a by each of the both principal planes of the PE film 7.

[0006]In the cell proper 8 using a fuel cell cell with the above-mentioned composition, although fuel gas is supplied to the fuel electrode film 61 and oxidant gas is supplied to the oxidant electrode film 62, Reactant gas (in naming fuel gas and oxidant gas generically, there is what is said in this way.), such as this, is changed into the state where humidified and the steam was included, and is supplied. As the Reason described the PE film 7 above, it is a film which functions as a proton conductivity electrolyte by water being carried out to saturation, but it is because the PE film 7 will be a film on which proton conductivity falls to and the resistivity increases when it dries and the moisture content is reduced if a reverse thing is said. The catalyst beds 61a and 62a with which each electrode layer 61 and 62 was equipped when reactant gas was supplied to the fuel electrode film 61 and the oxidant electrode film 62, Direct current power is generated by the three-phase zone of the gaseous phase (fuel gas or oxidant gas), the liquid phase (liquefied H₂O), and solid phase (catalyst which a fuel electrode and an oxidant electrode have) being formed in an interface with the PE film 7, and making it produce electrochemical reaction. In many cases, the catalyst beds 61a and 62a are formed from the platinum catalyst of minute particle state, and the fluoro-resin which has water repellence. and by much fine pores being formed in a layer, the efficient diffusion to the three-phase zone of reactant gas is maintained — it carries out, and it is constituted so that the three-phase zone of a sufficiently large area may be formed.

[0007]In this three-phase zone, the electrochemical reaction which carries out the account of following arises. First, the reaction by (1) type occurs in the fuel electrode film 61 side.

[0008]

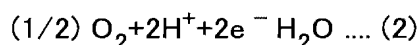
[Formula 1]



The reaction by (2) types occurs in the oxidant electrode film 62 side.

[0009]

[Formula 2]



That is, as a result of this reaction, the H⁺ ion (proton) generated by the fuel electrode film 61 moves toward the oxidant electrode film 62 in the inside of the PE film 7, and an electron (e⁻) moves it to the oxidant electrode film 62 through the load apparatus 9. On the other hand, in the oxidant electrode film 62, the oxygen contained in oxidant gas, the H⁺ ion which has moved from the fuel electrode film 61 in the inside of the PE film 7, and the electron which has moved through the load apparatus 9 react, and H₂O (steam) is generated. In this way, the cell proper 8 obtains hydrogen and oxygen, and generates direct current power, then is generating H₂O (steam) as a by-product.

[0010]By the way, it makes the catalyst beds 61a and 62a counter for them the principal surface where the PE films 7 differ mutually, makes them, and a fuel cell cell piles up the PE film 7 prepared separately, respectively, the fuel electrode film 61, and the oxidant electrode film 62, and is carrying out them as [join / perform heating and application of pressure and]. Thus, the obtained fuel cell cell is provided with the structure and shape indicated to be drawing 5 in drawing 6. Drawing 5 is a side sectional view of the important section typically shown where the fuel cell cell of the conventional example used for the cell proper shown in drawing 4 is developed here. That is, the fuel cell cell 6 is making rectangular shape with thin thickness, and the PE film 7 used for this has an outside dimension of a larger plane direction than the outside dimension of the plane direction of the fuel electrode film 61 and the oxidant electrode film 62. Therefore, as shown in drawing 5 and drawing 6 between the ends of the PE film 7, the exposed surface of the PE film 7 exists in the periphery of the fuel electrode film 61 and the oxidant

electrode film 62.

In many cases, the width dimension of this fuel cell cell 6 is 1. [mm] The width dimension of the PE film 7 which is a grade or less than it, and constitutes the fuel cell cell 6 in that case is 0.1. [mm] -0.2 [mm] It is a grade.

[0011] This fuel cell cell 6 is included in the unit fuel cell device 5 with the composition shown in drawing 6, the number which this unit fuel cell device 5 needs is laminated, and the cell proper 8 is formed. Drawing 6 is a side sectional view of an important section showing typically the unit fuel cell device of the general example constituted using the fuel cell cell shown in drawing 5 here. Into drawing 6, only typical numerals were described about the numerals attached by drawing 5. The separator 51 with two or more slots 51a which the unit fuel cell device 5 is allocated [slots] in one side of the fuel cell cell 6 and this fuel cell cell 6, and carry out conduction of the fuel gas 5a in drawing 6, With the separator 52 with two or more slots 52a which are allocated in the side of another side of the fuel cell cell 6, and carry out conduction of the oxidant gas 5b, it has the seal bodies 53, such as an O ring, for example. Each separator 51 and 52 is the periphery which has exposed the PE film 7, and via the seal body 53, as it sandwiches the fuel cell cell 6, it is allocated. The duty which prevents it from the reactant gas which carries out conduction leaking outside a flowing path, and coming out of the seal body 53 into the slot 51a of the separators 51 and 52 and 52a is undertaken. It is inserted in and equipped into the slot 51b formed in the edge part of each separator 51 and 52, and 52b.

[0012] As for the reactant gas supplied to the fuel cell cell 6, it is general to be arranged so that the discharge side may be turned down to a gravity direction up to a gravity direction in the supply side. In the fuel cell cell 6, as described above, a steam is generated as a by-product at the time of power generation, but this. It is because there is a possibility of the steam which a steam will contain the reactant gas of the downstream in a large quantity, and is equivalent to supersaturation with the reactant gas near a discharge end as a result for this steam condensing, and existing as water of a liquid state. The water solidified by arranging the supply side of reactant gas so that the discharge side of reactant gas may be turned down to a gravity direction up to a gravity direction, Since it can flow down by itself with gravity in the slot 51a for reactant gas conduction, and 52a, removal of the water solidified from each unit fuel cell device 5 becomes easy.

[0013] By the way, the electrochemical reaction described by the aforementioned (1) ceremony held by the fuel cell cell 6 and (2) formulas is an exoergic reaction. Therefore, when generating electricity according to the electrochemical reaction by (1) type and (2) types by the fuel cell cell 6, it is not avoided that the heat of an equivalent value occurs mostly with the direct-current-power value generated, either. For this reason, when it constitutes the cell proper 8 using the unit fuel cell device 5, the cooling method which is not illustrated for removing heat from the fuel cell cell 6 is incorporated. Thereby, the fuel cell cell 6 is 70. [°C] ** et al. [80] [°C] Being operated by the temperature conditions of a grade is general.

[0014] Then, when an example of the fuel cell cell 6 of conventional technology is shown concretely, as the PE film 7, a width dimension is 0.17. The Nafion film of [mm] is used. As the electrode layer substrates 61b and 62b, a width dimension is 0.4. The carbon paper of [mm] is used. It is platinum black 20 [%] It is the supported dispersion mixed liquor of carbon powder and polytetraethylene to the aforementioned electrode layer substrates 61b and 62b 0.025 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h] 365 after drying [°C] — 15 It is calcinating between [min]. This has obtained the fuel electrode film 61 and the oxidant electrode film 62 in which the catalyst beds 61a and 62a were formed on the electrode layer substrate 61b and 62b. It is the sandwiching body which sandwiched the PE film 7 for this fuel electrode film 61 and the oxidant electrode film 62 in between by the catalyst bed 61a and catalyst bed 62a side 120 [°C] , 3.5 It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 6 has been obtained.

[0015] [Problem(s) to be Solved by the Invention] Although the solid polyelectrolyte type fuel cell

provided with desired power generation performance has been obtained using the fuel cell cell for solid polyelectrolyte type fuel cells by the conventional technology mentioned above, a problem which carries out the account of following remains. That is, as mentioned above, the electrochemical reaction produced in the fuel cell cell is a reaction to which the byproduction of the steam is carried out by an oxidant electrode film, and this steam is mainly discharged in oxidant gas from an oxidant electrode film. For this reason, it increases one by one and few water vapor contents in oxidant gas go as there are at the inlet section of a fuel cell cell and they pass a fuel cell cell. In order to make produced water easy to discharge in oxidant gas from an oxidant electrode film in that case, it is desirable to make the water-vapor-pressure power value in an oxidant electrode film higher than the water-vapor-pressure power value in oxidant gas.

[0016]Supposing the temperature of an oxidant electrode film is uniform, since the water vapor content in oxidant gas increases near the exit part from a fuel cell cell, the water-vapor-pressure power value of oxidant gas will become high for the above-mentioned Reason. For this reason, discharge of the produced water from the oxidant electrode film near the exit part becomes difficult. When the water-vapor-pressure power value in oxidant gas reached and waits to saturation water vapor pressure (the probability generated [near the exit part] for the aforementioned Reason is high.), Since discharge of the produced water from an oxidant electrode film will be in a halt condition, the produced water which the steam generated by the reaction condensed and became liquefied will stagnate so much in an oxidant electrode film. If produced water stagnates so much in an oxidant electrode film, it will become a situation where at least a part of opening which the fine pores in a catalyst bed will be full with produced water, or is formed in the electrode layer substrate will be full with produced water. If it becomes like this, diffusion of the oxidant gas within an oxidant electrode film will be checked, the reaction in the fuel cell cell mentioned above will fall, and it will come to cause the fall of the power generation performance of a fuel cell cell.

[0017]Although it is possible to reduce the water vapor content included in the oxidant gas supplied to a fuel cell cell as a plan of preventing produced water from stagnating so much in an oxidant electrode film, In this case, since a possibility of causing the fall of the output characteristics of a fuel cell when the resistivity of PE film increases will arise if PE film dries by reducing the water vapor content to include too much, the new problem that adjustment and management of the degree of humidification of oxidant gas become very difficult occurs.

[0018]this invention is made in view of the problem of the above-mentioned conventional technology, and comes out. The purpose is to provide the fuel cell cell for solid polyelectrolyte type fuel cells which stagnation of excessive produced water does not generate in a film.

[0019]

[Means for Solving the Problem]In this invention, in response to supply of 1 fuel gas and oxidant gas, the above-mentioned purpose is direct current power a fuel cell cell to generate, and Sheet shaped solid polyelectrolyte membrane, Have sheet shaped fuel electrode film and sheet shaped oxidant electrode film which are joined to each of both principal planes of this solid polyelectrolyte membrane, and each fuel electrode film and an oxidant electrode film, An electrode layer substrate of a sheet shaped [porosity which a course which supplies fuel gas or oxidant gas to a catalyst bed is provided, and has a function as a charge collector], It has the catalyst bed superficially supported all over almost by the side of one side of an electrode layer substrate, It is stuck by each of both principal planes of solid polyelectrolyte membrane by each catalyst bed side, In a fuel cell cell for solid polyelectrolyte type fuel cells which is that by which conduction of fuel gas and the oxidant gas is carried out to the side side of another side which is an anti-catalyst bed side, respectively, A catalyst bed which an oxidant electrode film has at least has composition which differs in a holding amount of a catalyst which a catalyst bed has by a place for square [of a catalyst bed], Or a thing for which a holding amount of a catalyst which a catalyst bed has in 2 aforementioned 1 paragraph in a means of a description is considered as more composition than a catalyst bed near the entrance of oxidant gas in a catalyst bed near the exit of oxidant gas by which conduction is carried out, It is alike and is attained more.

[0020]

[Function] Since the electrochemical reaction shown in the aforementioned (1) type and (2) types is a reaction performed by involving a catalyst as mentioned above, the quantity of heat generated in the case of this electrochemical reaction is generated corresponding to the holding amount of the catalyst of a fuel cell cell. This invention is performed paying attention to this point.

[0021] Namely, the catalyst bed which an oxidant electrode film has at least in the fuel cell cell for solid polyelectrolyte type fuel cells in this invention, It considers making larger than the holding amount of the catalyst which the catalyst bed near the entrance of oxidant gas has the holding amount of the catalyst which the catalyst bed which the holding amount of the catalyst which a catalyst bed has has near the exit of the oxidant gas by which conduction is carried out, for example has etc. as the composition which changes with places of the plane direction of a catalyst bed.

Therefore, in an oxidant electrode film at least, calorific value [/ near the exit of reactant gas] will increase [near the entrance of reactant gas] with the relation of the holding amount of a catalyst.

[0022] This measures temperature with temperature at the time of operation of the oxidant electrode film near the inlet section of oxidant gas at the time of operation of the oxidant electrode film in near the exit part of oxidant gas, The discharge ability of the produced water from the oxidant electrode film near the outlet side of oxidant gas to oxidant gas will improve because it can make highly on the level it becomes easy to discharge of the produced water from the oxidant electrode film near the exit part.

[0023] Since oxygen in reactant gas, for example, oxidant gas, is consumed by the electrochemical reaction in a fuel cell cell, the oxygen density in oxidant gas falls with the oxidant gas near the exit part to the oxidant gas near the inlet section. the fuel cell cell of this invention provided with the aforementioned composition has -- in an oxidant electrode film at least. Since the competence of electrochemical reaction [/ near the exit of reactant gas] increases, For example, even if it is reactant gas near [to which the oxygen density fell] the exit part, the Electrochemistry Sub-Division reactivity [/ near the inlet section] and the almost same Electrochemistry Sub-Division reactivity can be maintained, and Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of a fuel cell cell side can be made almost uniform.

[0024]

[Example] Working example of this invention is described in detail with reference to Drawings below. Drawing 2 is a side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by one working example of this invention is developed. (When distinguishing from different working example etc. which carry out a postscript, it may be called working example **.) In drawing 2, the same numerals are given to the fuel cell cell and identical parts for solid polyelectrolyte type fuel cells by the conventional example shown in drawing 5, and the explanation is omitted.

[0025] In drawing 2, 2 is the fuel cell cell which changes to the oxidant electrode film 62 and used the oxidant electrode (cathode) film 12 to the fuel cell cell 6 by the conventional example shown in drawing 5. To the oxidant electrode film 62 which the fuel cell cell 6 of the conventional example shown in drawing 5 has, the oxidant electrode film 12 is changed to the catalyst bed 62a, changes the catalyst bed 121 to the electrode layer substrate 62b, and he is trying to use the electrode layer substrate 122 for it.

[0026] The width dimension of the electrode layer substrate 122 is 0.4 as a porous electrode layer substrate like the electrode layer substrate 62b. Although the carbon paper of [mm] is used, as shown in drawing 2, the oxidant gas 5b is divided into two in accordance with the direction by which conduction is carried out at the electrode layer substrates 122a and 122b, respectively. Then, in the electrode layer substrate 122a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after

drying [**] -- 15 It calcinates between [min] and the catalyst bed 121a is formed.

[0027]In the electrode layer substrate 122b of the downstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] -- 15 It calcinates between [min] and the catalyst bed 121b is formed. Then, the catalyst bed 121 is formed by the catalyst bed 121a and the catalyst bed 121b.

[0028]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 61 and the oxidant electrode films 12, such as this, in between by the catalyst bed 61a and catalyst bed 121 side 120 [**], 3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 2 has been obtained. Since it had the above-mentioned composition in working example shown in drawing 2, in the oxidant electrode film 12, calorific value [/ near the exit of the oxidant gas 5b] will increase [near the entrance of the oxidant gas 5b] with the relation of the holding amount of a catalyst. For this reason, temperature can be positively made highly as compared with temperature on the level it becomes easy to discharge of the produced water from the oxidant electrode film 12 near the exit part at the time of operation of the oxidant electrode film 12 near the inlet section of the oxidant gas 5b at the time of operation of the oxidant electrode film [/ near the exit part of the oxidant gas 5b] 12. By this, the discharge ability of the produced water from the oxidant electrode film 12 near the exit part of the oxidant gas 5b to the oxidant gas 5b will improve. Since the competence of electrochemical reaction [/ near the exit of the oxidant gas 5b] increases, even if it is the oxidant gas 5b near [to which the oxygen density fell] the exit part, the Electrochemistry Sub-Division reactivity [/ near the inlet section] and the almost same Electrochemistry Sub-Division reactivity are maintainable. For this reason, the uniformity coefficient of the Electrochemistry Sub-Division reactivity in the direction of oxidant gas 5b conduction of the surface of the fuel cell cell 2 can be improved.

[0029]Drawing 1 is a side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by working example from which this invention differs is developed. (When distinguishing from other working example, it may be called working example **.) In drawing 1, The same numerals are given to the fuel cell cell for solid polyelectrolyte type fuel cells by one working example of this invention shown in drawing 2, and the fuel cell cell and identical parts for solid polyelectrolyte type fuel cells by the conventional example shown in drawing 5, and that explanation is omitted.

[0030]In drawing 1, 1 is the fuel cell cell which changes to the fuel electrode film 61 and used the fuel electrode (anode) film 11 to the fuel cell cell 2 by one working example of this invention shown in drawing 2. To the fuel electrode film 61 shown in drawing 2 and drawing 5, the fuel electrode film 11 is changed to the catalyst bed 61a, changes the catalyst bed 111 to the electrode layer substrate 61b, and he is trying to use the electrode layer substrate 112 for it.

[0031]The width dimension of the electrode layer substrate 112 is 0.4 as a porous electrode layer substrate like the electrode layer substrate 61b. Although the carbon paper of [mm] is used, as shown in drawing 1, the fuel gas 5a is divided into two in accordance with the direction by which conduction is carried out at the electrode layer substrates 112a and 112b. Then, in the electrode layer substrate 112a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] -- 15 It calcinates between [min] and the catalyst bed 111a is formed.

[0032]In the electrode layer substrate 112b of ***** of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] -- 15 It calcinates between [min] and the catalyst bed 111b is formed. Then, the catalyst bed 111 is formed by the catalyst bed 111a and the catalyst bed 111b.

[0033]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 11 and the oxidant electrode films 12, such as this, in between by the catalyst bed 111 and catalyst bed 121 side 120 [**], 3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 1 has been obtained. Since it had the

above-mentioned composition in working example shown in drawing 1, in addition to the composition in working example shown in drawing 2, calorific value [/ near the exit of the fuel gas 5a] will increase [near the entrance of the fuel gas 5a] due to the holding amount of a catalyst also the fuel electrode film 11. When calorific value [/ near the exit part of reactant gas] increases rather than calorific value [/ near the inlet section of reactant gas], both the fuel electrode film 11 and the oxidant electrode film 12, It becomes possible to make the temperature gradient over temperature higher than the case of working example shown in drawing 2 at the time of operation of the oxidant electrode film near [of the oxidant gas 5b] the inlet section of temperature at the time of operation of the oxidant electrode film [/ near the exit part of the oxidant gas 5b] 12. By this, the discharge ability of the produced water from the oxidant electrode film 12 near the exit part to the oxidant gas 5b will improve further. Since the competence of electrochemical reaction [/ near the exit of the fuel gas 5a] also increases when it receives the oxidant gas 5b in addition, even if it is the fuel gas 5a near [to which hydrogen concentration fell] an outlet side, the Electrochemistry Sub-Division reactivity in near an entrance side and the almost same Electrochemistry Sub-Division reactivity are maintainable. For this reason, Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of both the surfaces of the fuel cell cell 2 can be made almost uniform.

[0034]Drawing 3 is a side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by further different working example of this invention is developed. (When distinguishing from other working example, it may be called working example **.) In drawing 3, the same numerals are given to the fuel cell cell and identical parts by the conventional example shown in drawing 5, and the explanation is omitted.

[0035]In drawing 3, 3 is changed to the fuel electrode film 61 and the oxidant electrode film 62 to the fuel cell cell 6 by the conventional example shown in drawing 5, and is the fuel cell cell which used the fuel electrode (anode) film 31 and the oxidant electrode (cathode) film 32, respectively. To the fuel electrode film 61 which the fuel cell cell 6 of the conventional example shown in drawing 5 has, the fuel electrode film 31 is changed to the catalyst bed 61a, changes the catalyst bed 311 to the electrode layer substrate 61b, and he is trying to use the electrode layer substrate 312 for it. To the oxidant electrode film 62 which the fuel cell cell 6 of the conventional example shown in drawing 5 has, the oxidant electrode film 32 is changed to the catalyst bed 62a, changes the catalyst bed 321 to the electrode layer substrate 62b, and he is trying to use the electrode layer substrate 322 for it.

[0036]The width dimension of each electrode layer substrate 312,322 is 0.4 as a porous electrode layer substrate like the electrode layer substrates 61b and 62b. Although the carbon paper of [mm] is used, as shown in drawing 3, the fuel gas 5a and the oxidant gas 5b are trichotomized in accordance with the direction by which conduction is carried out, respectively, without the electrode layer substrates 312a, 312b, and 312c and the electrode layer substrates 322a, 322b, and 322c. Then, in each electrode layer substrate 312a and 322a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311a and 321a are formed.

[0037]In each electrode layer substrate 312b and 322b of the middle class region of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.025 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311b and 321b are formed. In each electrode layer substrate 312c and 322c of the downstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311c and 321c are formed. Then, the catalyst bed 311 is formed by the catalyst bed 311a, the catalyst bed 311b, and the catalyst bed 311c, and the catalyst bed 321 is formed by the catalyst bed 321a, the catalyst bed 321b, and the catalyst bed 321c.

[0038]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 31

and the oxidant electrode films 32, such as this, in between by the catalyst bed 311 and catalyst bed 321 side 120 [**], 3.5 It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 3 has been obtained. It compares with the case of the composition in working example shown in drawing 1 since it had the above-mentioned composition in working example shown in drawing 3, and is an either electrode film (in naming generically fuel electrode film 31 grade and oxidant electrode film 32 grade). It may say in this way. Due to the holding amount of a catalyst, the degree of increase of the calorific value [it results near the exit part of reactant gas near the inlet section of reactant gas] of a between will be equated. For this reason, it becomes possible to be made to make high change [it results near the exit part of the oxidant gas 5b near / of the oxidant gas 5b / the inlet section of temperature at the time of operation of the oxidant electrode film 32] of a between gradually. Thereby, it becomes possible to raise the discharge ability of the produced water from the oxidant electrode film 12 to the oxidant gas 5b almost over the whole surface of the oxidant electrode film 32 including the neighborhood of an exit part. It becomes possible to equalize further the Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of both the surfaces of the fuel cell cell 2.


[0039]The example of survey of the temperature distribution which a fuel electrode film and an oxidant electrode film have is collectively shown all over "Table 1" about each of the unit fuel cell device using the fuel cell cell by working example ** explained by the paragraph of this working example until now - **, and the fuel cell cell of the conventional example. the degree of fall of the pressure value which evaluation of stability operates each unit fuel cell device continuously for 24 hours, and each unit fuel cell device outputs in "Table 1" — 2 [%] What was the following considers it as O, and is 2. [%] What it was above is taken as **.

[0040]

[Table 1]

燃料電池セルの反応ガス通流方向の温度分布の実測例

〔単位：℃〕

温度の測定点		実施例①		実施例②		実施例③		従来例		
		場所	a側	b側	a側	b側	a側	b側	a側	b側
燃料ガス側 (a側)  ①a ②a ③a ④a ⑤a	酸化剤ガス側 (b側) ①b ②b ③b ④b ⑤b	①	69.1	69.1	69.2	69.0	69.2	69.3	69.0	69.2
	②	70.5	70.6	70.4	70.3	70.5	70.7	69.9	69.8	
	③	71.9	72.0	72.2	72.2	72.1	72.4	71.2	70.8	
	④	73.7	73.9	73.8	74.2	73.8	74.0	71.9	71.7	
	⑤	75.2	75.5	75.7	75.6	75.5	75.8	72.3	72.2	
出力の安定性		○		○		○		△		

[0041]in "Table 1", when its attention is paid to a temperature gradient with the temperature (**a in "Table 1", **b) of the inlet section of reactant gas, and the temperature (**a in "Table 1", **b) of the exit part of reactant gas, the temperature gradients in a conventional example are few — about 3 By the case of working example ** by this invention - **, it is 6-7 to being by [**]. [**] The temperature gradient of the grade is acquired. Produced water's stagnating so much by this into the oxidant electrode film 12 and 32 including the neighborhood of an exit part of reactant gas is canceled, and it can check that the degree of fall of the output voltage value which it becomes a main cause that produced water stagnates so much, and is generated is decreasing.

[0042] Came by old explanation in working example noting that the electrode layer substrate 112,122,312,322 with which the fuel cell cells 1-3 are provided was divided in the direction in which reactant gas carries out conduction at plurality, but. The electrode layer substrate not the thing limited to this but the fuel electrode film with which the fuel cell cells 1-3 are provided, for example, and for oxidant electrode films may be a thing of one, The catalyst bed formed on an electrode layer substrate changes thickness in the direction in which reactant gas carries out conduction to this electrode layer substrate of one, and may be formed in it.

[0043]

[Effect of the Invention] In this invention, the fuel cell cell for solid polyelectrolyte type fuel cells is considered as the above-mentioned composition.

Therefore, if its attention is paid to the temperature gradient between the inlet section of reactant gas, and an exit part, as shown all over Table 1, it will become possible to acquire a more than twice as many temperature gradient as this to the case of a conventional example. Since it is canceled that produced water stagnates so much into an oxidant electrode film at least, and diffusion of oxidant gas is checked within an oxidant electrode film by this, an effect that the degree of fall of the output voltage value of a fuel cell cell decreases is done so.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application]This invention relates to that composition improved so that produced water might be prevented from stagnating too much in an oxidant electrode film with respect to the fuel cell cell used for a solid polyelectrolyte type fuel cell.

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PRIOR ART

[Description of the Prior Art]A fuel cell is a kind of power plant which generates direct current power using hydrogen and oxygen, and it is compared with other Energy Agencies as it is already known well, The conversion efficiency to electrical energy is high, and moreover, since there are few discharges of air pollution substances, such as carbon dioxide and nitrogen oxides, it is expected as what is called a source of clean energy. As this fuel cell, various kinds of fuel cells, such as a solid polymer electrolyte type, a phosphoric acid type, a melting carbonate type, and a solid oxide type, are known by the kind of electrolyte used.

[0003]In recent years, since it has the big features, like that the air pollution degree of a fuel cell by exhaust gas is low, and the generating sound at the time of operation is small as compared with an internal-combustion engine, it can be possible to use as a mounted power supply for the electric motors for a drive which uses a fuel cell for the drive of vehicles, such as a car. When using a fuel cell as a mounted power supply, it is desirable for a power supply system to be small as much as possible, and a solid polyelectrolyte type fuel cell attracts attention increasingly also among various kinds of fuel cells from such a viewpoint.

[0004]When a solid polyelectrolyte type fuel cell carries out the water of the Polymer Division resin layer which has a proton (hydrogen ion) exchange group in a molecule to saturation, it is a fuel cell using low resistivity being shown and functioning as a proton conductivity electrolyte. As a Polymer Division resin layer (it is sometimes only henceforth called [solid polyelectrolyte membrane or] PE film for short.) which has a proton exchange group in this molecule, Although the fluorine system ion exchange resin membrane which makes representation a perfluoro sulfonic-acid-type-resin film (for example, the U.S. Du Pont make, a trade name Nafion film) is prominent at present, hydrocarbon system ion exchange resin membrane, bipolar membrane, etc. are used. By carrying out water to saturation, solid polyelectrolyte membrane (PE film), such as this, is ordinary temperature, and is 20. [Omega-cm] The following resistivity is shown and all are the films which function as a proton conductivity electrolyte.

[0005]Generally the system of this solid polyelectrolyte type fuel cell is constituted considering the cell proper 8 which shows drawing 4 that key map as a core. The cell proper 8 usually carries out the plural laminates of the fuel cell cell which consists of the sheet shaped PE film 7, and the sheet shaped fuel electrode (anode) film 61 joined to each of the both principal planes of this PE film 7 and the sheet shaped oxidant electrode (cathode) film 62, and is constituted. Each fuel electrode film 61 and the oxidant electrode film 62, Support the catalyst beds 61a and 62a and the catalyst beds 61a and 62a, and supply and discharge fuel gas (gas which contains hydrogen or hydrogen by high concentration.), or oxidant gas (gas which contains oxygen by high concentration like oxygen or air.) to the catalyst beds 61a and 62a, and. It comprises the electrode layer substrates (as the material of construction, carbon paper is used, for example.) 61b and 62b of the porosity which has a function as a charge collector. It is stuck to the catalyst beds 61a and 62a by each of the both principal planes of the PE film 7.

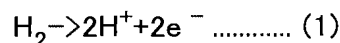
[0006]In the cell proper 8 using a fuel cell cell with the above-mentioned composition, although fuel gas is supplied to the fuel electrode film 61 and oxidant gas is supplied to the oxidant electrode film 62, Reactant gas (in naming fuel gas and oxidant gas generically, there is what is

said in this way.), such as this, is changed into the state where humidified and the steam was included, and is supplied. As the Reason described the PE film 7 above, it is a film which functions as a proton conductivity electrolyte by water being carried out to saturation, but it is because the PE film 7 will be a film on which proton conductivity falls to and the resistivity increases when it dries and the moisture content is reduced if a reverse thing is said. The catalyst beds 61a and 62a with which each electrode layer 61 and 62 was equipped when reactant gas was supplied to the fuel electrode film 61 and the oxidant electrode film 62, Direct current power is generated by the three-phase zone of the gaseous phase (fuel gas or oxidant gas), the liquid phase (liquefied H₂O), and solid phase (catalyst which a fuel electrode and an oxidant electrode have) being formed in an interface with the PE film 7, and making it produce electrochemical reaction. In many cases, the catalyst beds 61a and 62a are formed from the platinum catalyst of minute particle state, and the fluoro-resin which has water repellence. and by much fine pores being formed in a layer, the efficient diffusion to the three-phase zone of reactant gas is maintained — it carries out, and it is constituted so that the three-phase zone of a sufficiently large area may be formed.

[0007]In this three-phase zone, the electrochemical reaction which carries out the account of following arises. First, the reaction by (1) type occurs in the fuel electrode film 61 side.

[0008]

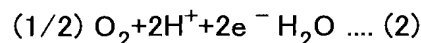
[Formula 1]



The reaction by (2) types occurs in the oxidant electrode film 62 side.

[0009]

[Formula 2]



That is, as a result of this reaction, the H⁺ ion (proton) generated by the fuel electrode film 61 moves toward the oxidant electrode film 62 in the inside of the PE film 7, and an electron (e⁻) moves it to the oxidant electrode film 62 through the load apparatus 9. On the other hand, in the oxidant electrode film 62, the oxygen contained in oxidant gas, the H⁺ ion which has moved from the fuel electrode film 61 in the inside of the PE film 7, and the electron which has moved through the load apparatus 9 react, and H₂O (steam) is generated. In this way, the cell proper 8 obtains hydrogen and oxygen, and generates direct current power, then is generating H₂O (steam) as a by-product.

[0010]By the way, it makes the catalyst beds 61a and 62a counter for them the principal surface where the PE films 7 differ mutually, makes them, and a fuel cell cell piles up the PE film 7 prepared separately, respectively, the fuel electrode film 61, and the oxidant electrode film 62, and is carrying out them as [join / perform heating and application of pressure and]. Thus, the obtained fuel cell cell is provided with the structure and shape indicated to be drawing 5 in drawing 6. Drawing 5 is a side sectional view of the important section typically shown where the fuel cell cell of the conventional example used for the cell proper shown in drawing 4 is developed here. That is, the fuel cell cell 6 is making rectangular shape with thin thickness, and the PE film 7 used for this has an outside dimension of a larger plane direction than the outside dimension of the plane direction of the fuel electrode film 61 and the oxidant electrode film 62. Therefore, as shown in drawing 5 and drawing 6 between the ends of the PE film 7, the exposed surface of the PE film 7 exists in the periphery of the fuel electrode film 61 and the oxidant electrode film 62.

In many cases, the width dimension of this fuel cell cell 6 is 1. [mm] The width dimension of the PE film 7 which is a grade or less than it, and constitutes the fuel cell cell 6 in that case is 0.1. [mm] -0.2 [mm] It is a grade.

[0011]This fuel cell cell 6 is included in the unit fuel cell device 5 with composition shown in drawing 6, the number which this unit fuel cell device 5 needs is laminated, and the cell proper 8

is formed. Drawing 6 is a side sectional view of an important section showing typically a unit fuel cell device of a general example constituted using a fuel cell cell shown in drawing 5 here. Into drawing 6, only typical numerals were described about numerals attached by drawing 5. The separator 51 with two or more slots 51a which the unit fuel cell device 5 is allocated [slots] in one side of the fuel cell cell 6 and this fuel cell cell 6, and carry out conduction of the fuel gas 5a in drawing 6. With the separator 52 with two or more slots 52a which are allocated in the side of another side of the fuel cell cell 6, and carry out conduction of the oxidant gas 5b, it has the seal bodies 53, such as an O ring, for example. Each separator 51 and 52 is the periphery which has exposed the PE film 7, and via the seal body 53, as it sandwiches the fuel cell cell 6, it is allocated. A duty which prevents it from reactant gas which carries out conduction leaking outside a flowing path, and coming out of the seal body 53 into the slot 51a of the separators 51 and 52 and 52a is undertaken.

It is inserted in and equipped into the slot 51b formed in an edge part of each separator 51 and 52, and 52b.

[0012]As for the reactant gas supplied to the fuel cell cell 6, it is general to be arranged so that the discharge side may be turned down to a gravity direction up to a gravity direction in the supply side. In the fuel cell cell 6, as described above, a steam is generated as a by-product at the time of power generation, but this. It is because there is a possibility of the steam which a steam will contain the reactant gas of the downstream in a large quantity, and is equivalent to supersaturation with the reactant gas near a discharge end as a result for this steam condensing, and existing as water of a liquid state. The water solidified by arranging the supply side of reactant gas so that the discharge side of reactant gas may be turned down to a gravity direction up to a gravity direction, Since it can flow down by itself with gravity in the slot 51a for reactant gas conduction, and 52a, removal of the water solidified from each unit fuel cell device 5 becomes easy.

[0013]By the way, the electrochemical reaction described by the aforementioned (1) ceremony held by the fuel cell cell 6 and (2) formulas is an exoergic reaction. Therefore, when generating electricity according to the electrochemical reaction by (1) type and (2) types by the fuel cell cell 6, it is not avoided that the heat of an equivalent value occurs mostly with the direct-current-power value generated, either. For this reason, when it constitutes the cell proper 8 using the unit fuel cell device 5, the cooling method which is not illustrated for removing heat from the fuel cell cell 6 is incorporated. Thereby, the fuel cell cell 6 is 70. [**] ** et al. [80] [**] Being operated by the temperature conditions of a grade is general.

[0014]Then, when an example of the fuel cell cell 6 of conventional technology is shown concretely, as the PE film 7, a width dimension is 0.17. The Nafion film of [mm] is used. As the electrode layer substrates 61b and 62b, a width dimension is 0.4. The carbon paper of [mm] is used. It is platinum black 20 [%] It is the supported dispersion mixed liquor of carbon powder and polytetraethylene to the aforementioned electrode layer substrates 61b and 62b 0.025 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It is calcinating between [min]. This has obtained the fuel electrode film 61 and the oxidant electrode film 62 in which the catalyst beds 61a and 62a were formed on the electrode layer substrate 61b and 62b. It is the sandwiching body which sandwiched the PE film 7 for this fuel electrode film 61 and the oxidant electrode film 62 in between by the catalyst bed 61a and catalyst bed 62a side 120 [**] ,3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 6 has been obtained.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention]In this invention, the fuel cell cell for solid polyelectrolyte type fuel cells is considered as the above-mentioned composition.

Therefore, if its attention is paid to the temperature gradient between the inlet section of reactant gas, and an exit part, as shown all over Table 1, it will become possible to acquire a more than twice as many temperature gradient as this to the case of a conventional example. Since it is canceled that produced water stagnates so much into an oxidant electrode film at least, and diffusion of oxidant gas is checked within an oxidant electrode film by this, an effect that the degree of fall of the output voltage value of a fuel cell cell decreases is done so.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]Although the solid polyelectrolyte type fuel cell provided with desired power generation performance has been obtained using the fuel cell cell for solid polyelectrolyte type fuel cells by the conventional technology mentioned above, a problem which carries out the account of following remains. That is, as mentioned above, the electrochemical reaction produced in the fuel cell cell is a reaction to which the byproduction of the steam is carried out by an oxidant electrode film, and this steam is mainly discharged in oxidant gas from an oxidant electrode film. For this reason, it increases one by one and few water vapor contents in oxidant gas go as there are at the inlet section of a fuel cell cell and they pass a fuel cell cell. In order to make produced water easy to discharge in oxidant gas from an oxidant electrode film in that case, it is desirable to make the water-vapor-pressure power value in an oxidant electrode film higher than the water-vapor-pressure power value in oxidant gas.

[0016]Supposing the temperature of an oxidant electrode film is uniform, since the water vapor content in oxidant gas increases near the exit part from a fuel cell cell, the water-vapor-pressure power value of oxidant gas will become high for the above-mentioned Reason. For this reason, discharge of the produced water from the oxidant electrode film near the exit part becomes difficult. When the water-vapor-pressure power value in oxidant gas reached and waits to saturation water vapor pressure (the probability generated [near the exit part] for the aforementioned Reason is high.), Since discharge of the produced water from an oxidant electrode film will be in a halt condition, the produced water which the steam generated by the reaction condensed and became liquefied will stagnate so much in an oxidant electrode film. If produced water stagnates so much in an oxidant electrode film, it will become a situation where at least a part of opening which the fine pores in a catalyst bed will be full with produced water, or is formed in the electrode layer substrate will be full with produced water. If it becomes like this, diffusion of the oxidant gas within an oxidant electrode film will be checked, the reaction in the fuel cell cell mentioned above will fall, and it will come to cause the fall of the power generation performance of a fuel cell cell.

[0017]Although it is possible to reduce the water vapor content included in the oxidant gas supplied to a fuel cell cell as a plan of preventing produced water from stagnating so much in an oxidant electrode film, In this case, since a possibility of causing the fall of the output characteristics of a fuel cell when the resistivity of PE film increases will arise if PE film dries by reducing the water vapor content to include too much, the new problem that adjustment and management of the degree of humidification of oxidant gas become very difficult occurs.

[0018]this invention is made in view of the problem of the above-mentioned conventional technology, and comes out. The purpose is to provide the fuel cell cell for solid polyelectrolyte type fuel cells which stagnation of excessive produced water does not generate in a film.

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MEANS

[Means for Solving the Problem]In this invention, in response to supply of 1 fuel gas and oxidant gas, the above-mentioned purpose is direct current power a fuel cell cell to generate, and Sheet shaped solid polyelectrolyte membrane, Have sheet shaped fuel electrode film and sheet shaped oxidant electrode film which are joined to each of both principal planes of this solid polyelectrolyte membrane, and each fuel electrode film and an oxidant electrode film, An electrode layer substrate of a sheet shaped [porosity which a course which supplies fuel gas or oxidant gas to a catalyst bed is provided, and has a function as a charge collector], It has the catalyst bed superficially supported all over almost by the side of one side of an electrode layer substrate, It is stuck by each of both principal planes of solid polyelectrolyte membrane by each catalyst bed side, In a fuel cell cell for solid polyelectrolyte type fuel cells which is that by which conduction of fuel gas and the oxidant gas is carried out to the side side of another side which is an anti-catalyst bed side, respectively, A catalyst bed which an oxidant electrode film has at least has composition which differs in a holding amount of a catalyst which a catalyst bed has by a place for square [of a catalyst bed], Or a thing for which a holding amount of a catalyst which a catalyst bed has in 2 aforementioned 1 paragraph in a means of a description is considered as more composition than a catalyst bed near the entrance of oxidant gas in a catalyst bed near the exit of oxidant gas by which conduction is carried out, It is alike and is attained more.

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OPERATION

[Function]Since the electrochemical reaction shown in the aforementioned (1) type and (2) types is a reaction performed by involving a catalyst as mentioned above, the quantity of heat generated in the case of this electrochemical reaction is generated corresponding to the holding amount of the catalyst of a fuel cell cell. This invention is performed paying attention to this point.

[0021]Namely, the catalyst bed which an oxidant electrode film has at least in the fuel cell cell for solid polyelectrolyte type fuel cells in this invention, It considers making larger than the holding amount of the catalyst which the catalyst bed near the entrance of oxidant gas has the holding amount of the catalyst which the catalyst bed which the holding amount of the catalyst which a catalyst bed has has near the exit of the oxidant gas by which conduction is carried out, for example has etc. as the composition which changes with places of the plane direction of a catalyst bed.

Therefore, in an oxidant electrode film at least, calorific value [/ near the exit of reactant gas] will increase [near the entrance of reactant gas] with the relation of the holding amount of a catalyst.

[0022]This measures temperature with temperature at the time of operation of the oxidant electrode film near the inlet section of oxidant gas at the time of operation of the oxidant electrode film in near the exit part of oxidant gas, The discharge ability of the produced water from the oxidant electrode film near the outlet side of oxidant gas to oxidant gas will improve because it can make highly on the level it becomes easy to discharge of the produced water from the oxidant electrode film near the exit part.

[0023]Since oxygen in reactant gas, for example, oxidant gas, is consumed by the electrochemical reaction in a fuel cell cell, the oxygen density in oxidant gas falls with the oxidant gas near the exit part to the oxidant gas near the inlet section. the fuel cell cell of this invention provided with the aforementioned composition has -- in an oxidant electrode film at least. Since the competence of electrochemical reaction [/ near the exit of reactant gas] increases, For example, even if it is reactant gas near [to which the oxygen density fell] the exit part, the Electrochemistry Sub-Division reactivity [/ near the inlet section] and the almost same Electrochemistry Sub-Division reactivity can be maintained, and Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of a fuel cell cell side can be made almost uniform.

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EXAMPLE

[Example]Working example of this invention is described in detail with reference to Drawings below. Drawing 2 is a side sectional view of the important section typically shown where the fuel cell for solid polyelectrolyte type fuel cells by one working example of this invention is developed. (When distinguishing from different working example etc. which carry out a postscript, it may be called working example **.) In drawing 2, the same numerals are given to the fuel cell and identical parts for solid polyelectrolyte type fuel cells by the conventional example shown in drawing 5, and the explanation is omitted.

[0025]In drawing 2, 2 is the fuel cell which changes to the oxidant electrode film 62 and used the oxidant electrode (cathode) film 12 to the fuel cell 6 by the conventional example shown in drawing 5. To the oxidant electrode film 62 which the fuel cell 6 of the conventional example shown in drawing 5 has, the oxidant electrode film 12 is changed to the catalyst bed 62a, changes the catalyst bed 121 to the electrode layer substrate 62b, and he is trying to use the electrode layer substrate 122 for it.

[0026]The width dimension of the electrode layer substrate 122 is 0.4 as a porous electrode layer substrate like the electrode layer substrate 62b. Although the carbon paper of [mm] is used, as shown in drawing 2, the oxidant gas 5b is divided into two in accordance with the direction by which conduction is carried out at the electrode layer substrates 122a and 122b, respectively. Then, in the electrode layer substrate 122a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst bed 121a is formed.

[0027]In the electrode layer substrate 122b of the downstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst bed 121b is formed. Then, the catalyst bed 121 is formed by the catalyst bed 121a and the catalyst bed 121b.

[0028]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 61 and the oxidant electrode films 12, such as this, in between by the catalyst bed 61a and catalyst bed 121 side 120 [**], 3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell 2 has been obtained. Since it had the above-mentioned composition in working example shown in drawing 2, in the oxidant electrode film 12, calorific value [/ near the exit of the oxidant gas 5b] will increase [near the entrance of the oxidant gas 5b] with the relation of the holding amount of a catalyst. For this reason, temperature can be positively made highly as compared with temperature on the level it becomes easy to discharge of the produced water from the oxidant electrode film 12 near the exit part at the time of operation of the oxidant electrode film 12 near the inlet section of the oxidant gas 5b at the time of operation of the oxidant electrode film [/ near the exit part of the oxidant gas 5b] 12. By this, the discharge ability of the produced water from the oxidant electrode film 12 near the exit part of the oxidant gas 5b to the oxidant gas 5b will improve. Since the competence of electrochemical reaction [/ near the exit of the oxidant gas 5b] increases, even if it is the oxidant gas 5b near [to which the oxygen density fell] the exit part,

the Electrochemistry Sub-Division reactivity [/ near the inlet section] and the almost same Electrochemistry Sub-Division reactivity are maintainable. For this reason, the uniformity coefficient of the Electrochemistry Sub-Division reactivity in the direction of oxidant gas 5b conduction of the surface of the fuel cell cell 2 can be improved.

[0029]Drawing 1 is a side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by working example from which this invention differs is developed. (When distinguishing from other working example, it may be called working example **.) In drawing 1, The same numerals are given to the fuel cell cell for solid polyelectrolyte type fuel cells by one working example of this invention shown in drawing 2, and the fuel cell cell and identical parts for solid polyelectrolyte type fuel cells by the conventional example shown in drawing 5, and that explanation is omitted.

[0030]In drawing 1, 1 is the fuel cell cell which changes to the fuel electrode film 61 and used the fuel electrode (anode) film 11 to the fuel cell cell 2 by one working example of this invention shown in drawing 2. To the fuel electrode film 61 shown in drawing 2 and drawing 5, the fuel electrode film 11 is changed to the catalyst bed 61a, changes the catalyst bed 111 to the electrode layer substrate 61b, and he is trying to use the electrode layer substrate 112 for it.

[0031]The width dimension of the electrode layer substrate 112 is 0.4 as a porous electrode layer substrate like the electrode layer substrate 61b. Although the carbon paper of [mm] is used, as shown in drawing 1, the fuel gas 5a is divided into two in accordance with the direction by which conduction is carried out at the electrode layer substrates 112a and 112b. Then, in the electrode layer substrate 112a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] --- 15 It calcinates between [min] and the catalyst bed 111a is formed.

[0032]In the electrode layer substrate 112b of ***** of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] - - 15 It calcinates between [min] and the catalyst bed 111b is formed. Then, the catalyst bed 111 is formed by the catalyst bed 111a and the catalyst bed 111b.

[0033]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 11 and the oxidant electrode films 12, such as this, in between by the catalyst bed 111 and catalyst bed 121 side 120 [**] ,3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 1 has been obtained. Since it had the above-mentioned composition in working example shown in drawing 1, in addition to the composition in working example shown in drawing 2, calorific value [/ near the exit of the fuel gas 5a] will increase [near the entrance of the fuel gas 5a] due to the holding amount of a catalyst also the fuel electrode film 11. When calorific value [/ near the exit part of reactant gas] increases rather than calorific value [/ near the inlet section of reactant gas], both the fuel electrode film 11 and the oxidant electrode film 12, It becomes possible to make the temperature gradient over temperature higher than the case of working example shown in drawing 2 at the time of operation of the oxidant electrode film near [of the oxidant gas 5b] the inlet section of temperature at the time of operation of the oxidant electrode film [/ near the exit part of the oxidant gas 5b] 12. By this, the discharge ability of the produced water from the oxidant electrode film 12 near the exit part to the oxidant gas 5b will improve further. Since the competence of electrochemical reaction [/ near the exit of the fuel gas 5a] also increases when it receives the oxidant gas 5b in addition, even if it is the fuel gas 5a near [to which hydrogen concentration fell] an outlet side, the Electrochemistry Sub-Division reactivity in near an entrance side and the almost same Electrochemistry Sub-Division reactivity are maintainable. For this reason, Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of both the surfaces of the fuel cell cell 2 can be made almost uniform.

[0034]Drawing 3 is a side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by further different working example of this invention is developed. (When distinguishing from other working example, it may be called working example **.) In drawing 3, the same numerals are given to the fuel cell cell and identical parts by

the conventional example shown in drawing 5, and the explanation is omitted.

[0035]In drawing 3, 3 is changed to the fuel electrode film 61 and the oxidant electrode film 62 to the fuel cell cell 6 by the conventional example shown in drawing 5, and is the fuel cell cell which used the fuel electrode (anode) film 31 and the oxidant electrode (cathode) film 32, respectively. To the fuel electrode film 61 which the fuel cell cell 6 of the conventional example shown in drawing 5 has, the fuel electrode film 31 is changed to the catalyst bed 61a, changes the catalyst bed 311 to the electrode layer substrate 61b, and he is trying to use the electrode layer substrate 312 for it. To the oxidant electrode film 62 which the fuel cell cell 6 of the conventional example shown in drawing 5 has, the oxidant electrode film 32 is changed to the catalyst bed 62a, changes the catalyst bed 321 to the electrode layer substrate 62b, and he is trying to use the electrode layer substrate 322 for it.

[0036]The width dimension of each electrode layer substrate 312,322 is 0.4 as a porous electrode layer substrate like the electrode layer substrates 61b and 62b. Although the carbon paper of [mm] is used, as shown in drawing 3, the fuel gas 5a and the oxidant gas 5b are trichotomized in accordance with the direction by which conduction is carried out, respectively, without the electrode layer substrates 312a, 312b, and 312c and the electrode layer substrates 322a, 322b, and 322c. Then, in each electrode layer substrate 312a and 322a of the upstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.02 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311a and 321a are formed.

[0037]In each electrode layer substrate 312b and 322b of the middle class region of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.025 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311b and 321b are formed. In each electrode layer substrate 312c and 322c of the downstream of reactant gas, it is the dispersion mixed liquor of the case of a conventional example, and an identical content 0.03 It is made to adhere to the uniform thickness of [mm], and is 24 by a vacuum dryer. [h]365 after drying [**] — 15 It calcinates between [min] and the catalyst beds 311c and 321c are formed. Then, the catalyst bed 311 is formed by the catalyst bed 311a, the catalyst bed 311b, and the catalyst bed 311c, and the catalyst bed 321 is formed by the catalyst bed 321a, the catalyst bed 321b, and the catalyst bed 321c.

[0038]It is the sandwiching body which sandwiched the PE film 7 for the fuel electrode film 31 and the oxidant electrode films 32, such as this, in between by the catalyst bed 311 and catalyst bed 321 side 120 [**], 3.5It is the conditions of [MPa] and is 15. It heated and pressurized between [min], both films were joined, and the fuel cell cell 3 has been obtained. It compares with the case of the composition in working example shown in drawing 1 since it had the above-mentioned composition in working example shown in drawing 3, and is an either electrode film (in naming generically fuel electrode film 31 grade and oxidant electrode film 32 grade). It may say in this way. Due to the holding amount of a catalyst, the degree of increase of the calorific value [it results near the exit part of reactant gas near the inlet section of reactant gas] of a between will be equated. For this reason, it becomes possible to be made to make high change [it results near the exit part of the oxidant gas 5b near / of the oxidant gas 5b / the inlet section of temperature at the time of operation of the oxidant electrode film 32] of a between gradually. Thereby, it becomes possible to raise the discharge ability of the produced water from the oxidant electrode film 12 to the oxidant gas 5b almost over the whole surface of the oxidant electrode film 32 including the neighborhood of an exit part. It becomes possible to equalize further the Electrochemistry Sub-Division reactivity in the direction of reactant gas conduction of both the surfaces of the fuel cell cell 2.

[0039]The example of survey of the temperature distribution which a fuel electrode film and an oxidant electrode film have is collectively shown all over "Table 1" about each of the unit fuel cell device using the fuel cell cell by working example ** explained by the paragraph of this working example until now - **, and the fuel cell cell of the conventional example. the degree of fall of the pressure value which evaluation of stability operates each unit fuel cell device


continuously for 24 hours, and each unit fuel cell device outputs in "Table 1" -- 2 [%] What was the following considers it as O, and is 2. [%] What it was above is taken as **.

[0040]

[Table 1]

燃料電池セルの反応ガス通流方向の温度分布の実測例

〔単位：℃〕

温度の測定点		実施例①		実施例②		実施例③		従来例			
		場所	a 側	b 側	a 側	b 側	a 側	b 側	a 側	b 側	
燃料ガス側 (a 側)		酸化物ガス側 (b 側)	①	69.1	69.1	69.2	69.0	69.2	69.3	69.0	69.2
			②	70.5	70.6	70.4	70.3	70.5	70.7	69.9	69.8
			③	71.9	72.0	72.2	72.2	72.1	72.4	71.2	70.8
			④	73.7	73.9	73.8	74.2	73.8	74.0	71.9	71.7
			⑤	75.2	75.5	75.7	75.6	75.5	75.8	72.3	72.2
出力の安定性			○		○		○		△		

[0041]in "Table 1", when its attention is paid to a temperature gradient with the temperature (**a in "Table 1", **b) of the inlet section of reactant gas, and the temperature (**a in "Table 1", **b) of the exit part of reactant gas, the temperature gradients in a conventional example are few -- about 3 By the case of working example ** by this invention -- **, it is 6-7 to being by [**]. [**] The temperature gradient of the grade is acquired. Produced water's stagnating so much by this into the oxidant electrode film 12 and 32 including the neighborhood of an exit part of reactant gas is canceled, and it can check that the degree of fall of the output voltage value which it becomes a main cause that produced water stagnates so much, and is generated is decreasing.

[0042]Came by old explanation in working example noting that the electrode layer substrate 112,122,312,322 with which the fuel cell cells 1-3 are provided was divided in the direction in which reactant gas carries out conduction at plurality, but. The electrode layer substrate not the thing limited to this but the fuel electrode film with which the fuel cell cells 1-3 are provided, for example, and for oxidant electrode films may be a thing of one, The catalyst bed formed on an electrode layer substrate changes thickness in the direction in which reactant gas carries out conduction to this electrode layer substrate of one, and may be formed in it.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by working example from which this invention differs is developed

[Drawing 2]The side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by one working example of this invention is developed

[Drawing 3]The side sectional view of the important section typically shown where the fuel cell cell for solid polyelectrolyte type fuel cells by further different working example of this invention is developed

[Drawing 4]The key map showing the solid polyelectrolyte type fuel cell of a general example

[Drawing 5]The side sectional view of the important section typically shown where the fuel cell cell for the solid polyelectrolyte type fuel cells of a conventional example is developed

[Drawing 6]The side sectional view of an important section showing typically the unit fuel cell device of the general example constituted using the fuel cell cell shown in drawing 5

[Description of Notations]

1 Fuel cell cell

11 Fuel electrode film

111 Catalyst bed

112 Electrode layer substrate

12 Oxidant electrode film

121 Catalyst bed

122 Electrode layer substrate

5a Fuel gas

5b Oxidant gas

[Translation done.]

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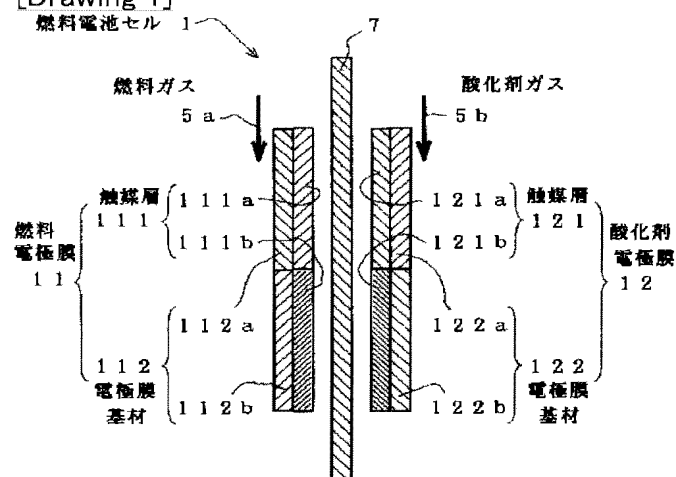
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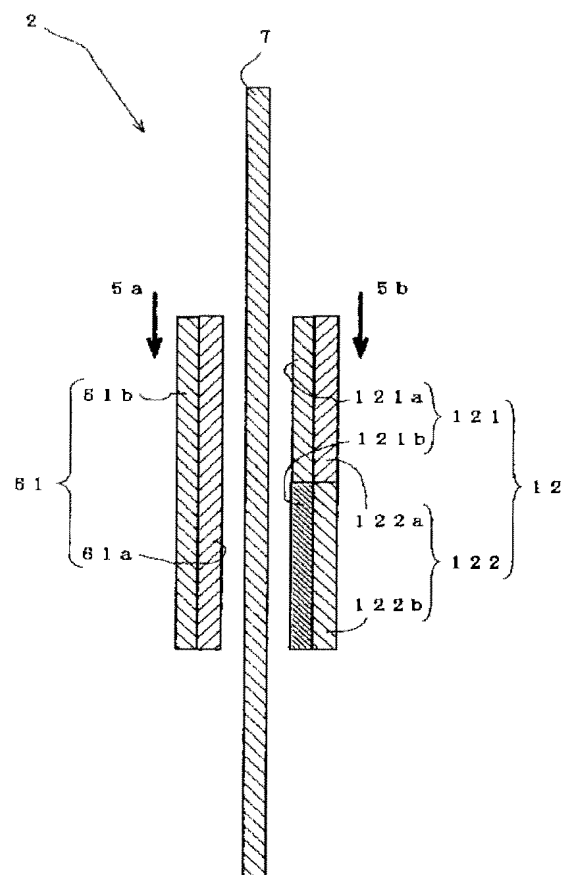
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DRAWINGS

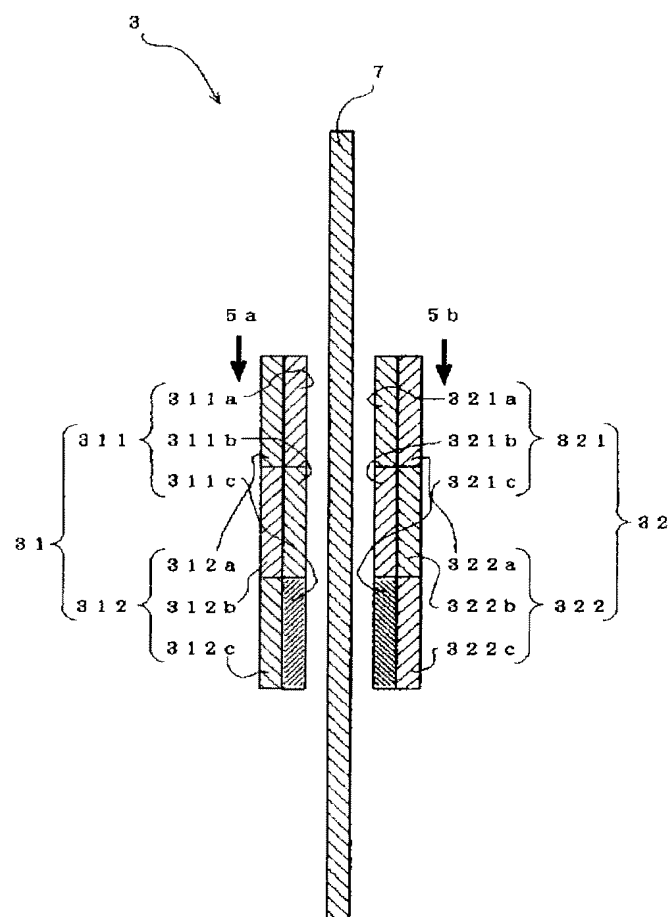
[Drawing 1]



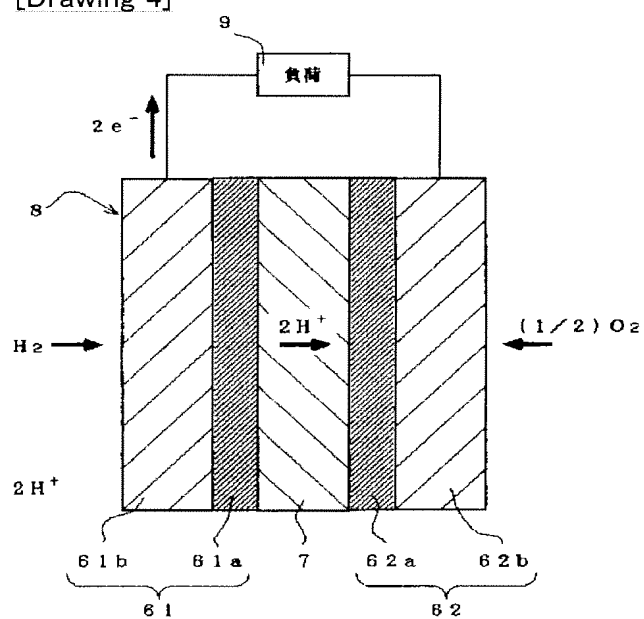
[Drawing 2]



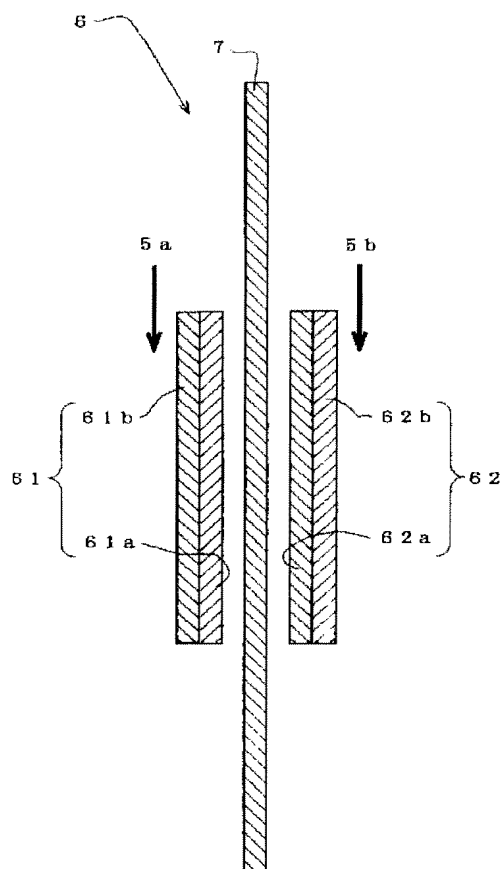
[Drawing 3]



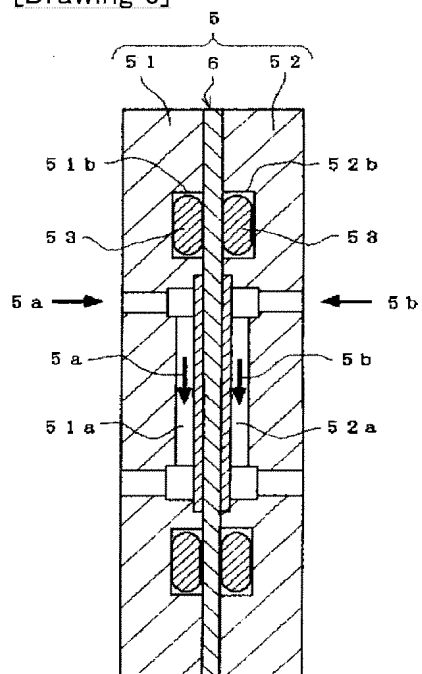
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]